INDUSTRIAL

FINISHING

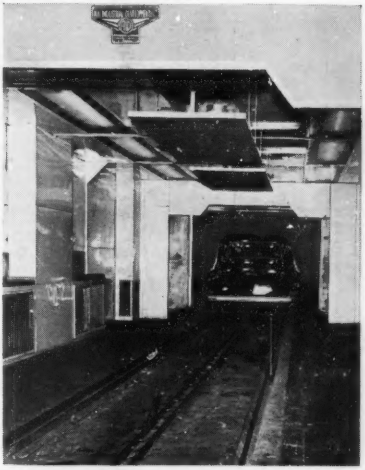
A. I. D. FOR INDUSTRY

NO. 3. THE MOTOR INDUSTRY

Here is shown a typical tunnel type spray booth as designed and installed by A.I.D. Ltd. for one of the leading car manufacturers in the country . . . indicating the importance of A.I.D. equipment in the motor industry for ensuring a complete flow of perfectly finished motor vehicles to meet the ever-increasing export demands.

The economy and efficiency of spray painting falls right into line with the need of industry to effect increased production and saving of man-hours, and the high quality finish attained with A.I.D. equipment in particular is appreciated on all sides.

Air Industrial Developments Ltd. cater for all trades. Whether your needs are large or small, do not hesitate to request the services of our technical organisation.



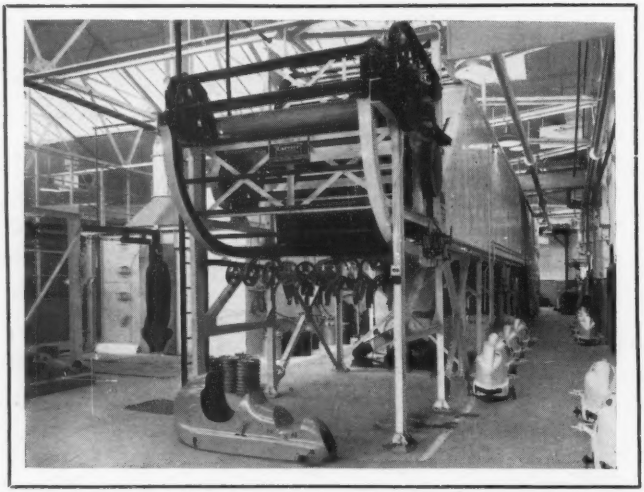
AID

THE GUN & EVERYTHING BEHIND THE GUN

Sole Manufacturers: AIR INDUSTRIAL DEVELOPMENTS LIMITED, Aidspray Works, Shenstone, Nr. Lichfield, Staffs., England. Phone: Shenstone 341/5. Grams: Aidspray, Shenstone. LONDON, 28 South Molton Street, W.1. Phone: Mayfair 6318. Grams: Aidspray, Wesdo. MANCHESTER, 141 Grove Lane, Cheadlehulme, Cheshire. SCOTTISH OFFICE, 90 Glasgow Road, Paisley. Phone: Paisley 3175. BRISTOL, Little Court, Golden Valley, Bitton, Nr. Bristol. CANADA: 350 Hillcrest Avenue, Willowdale, Nr. Toronto, Ontario. Phone: Baldwin 1/2677.

Carrier

INDUSTRIAL EQUIPMENT



'Carrier' Continuous Primer Bake Oven, part of a complete installation for finishing high quality toys

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NEWCASTLE-ON-TYNE, 1	Pudding Chare	*Newcastle-on-Tyne*	*21919*
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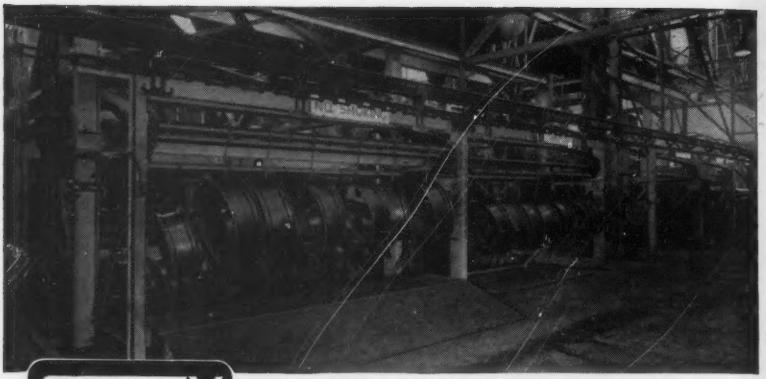
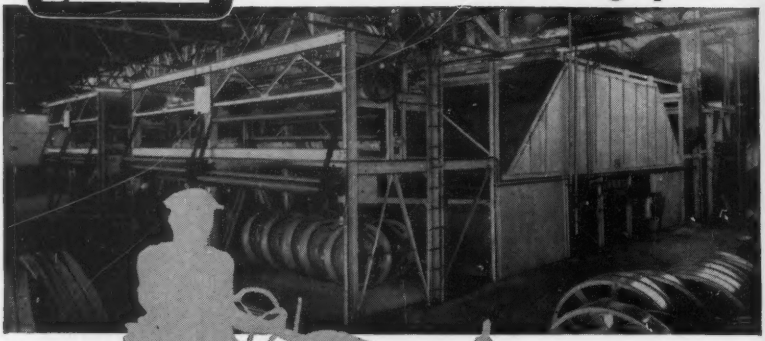


STORDY **modern finishing plant**



This plant was designed for a fully mechanised dipping and stoving operation for Tractor wheels. Heating is by direct oil firing and the combined crossbar width of the two ovens is 42 ft. The installation included three paint storage tanks of 4,500 gallons capacity and two of 3,500 gallons capacity, together with paint circulating equipment. This is one example of a complete finishing scheme designed and engineered by Stordy . . . equipment is built for the complete cycle in the application of paints, varnishes and all metal finishes including pretreatment and mechanical handling.
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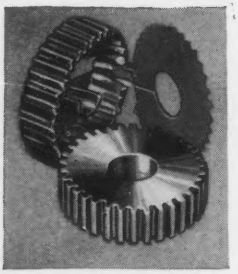

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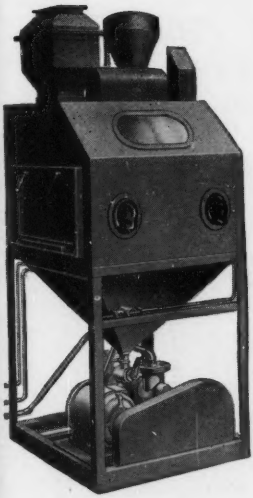

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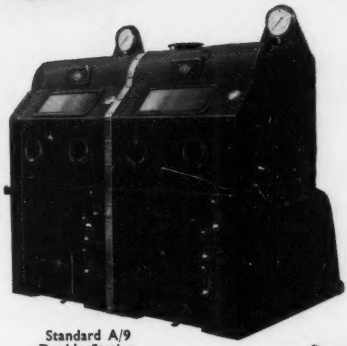
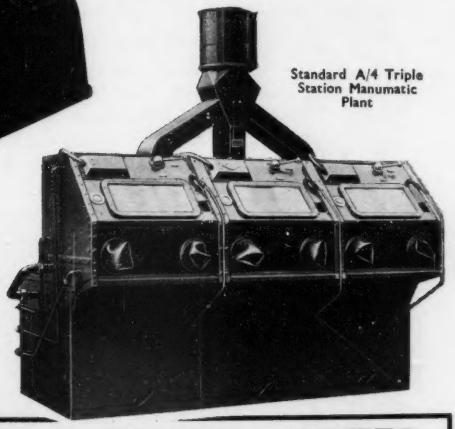
The price of this new unit is from £320. Orders now being accepted for two months' delivery.



Standard A/9 Double Station Plant



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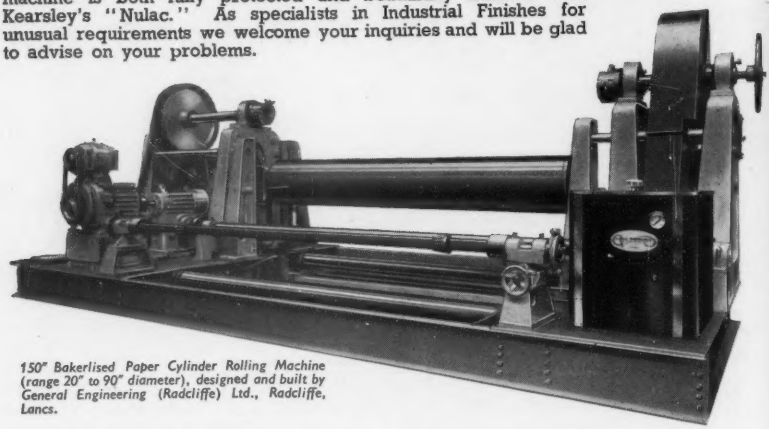

150" Bakerlised Paper Cylinder Rolling Machine (range 20" to 90" diameter), designed and built by General Engineering (Radcliffe) Ltd., Radcliffe, Lancs.

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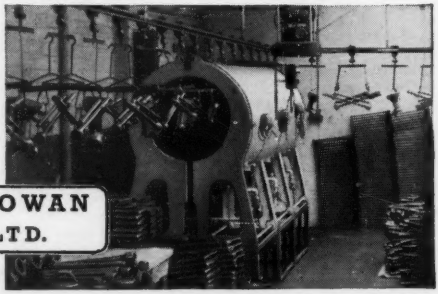

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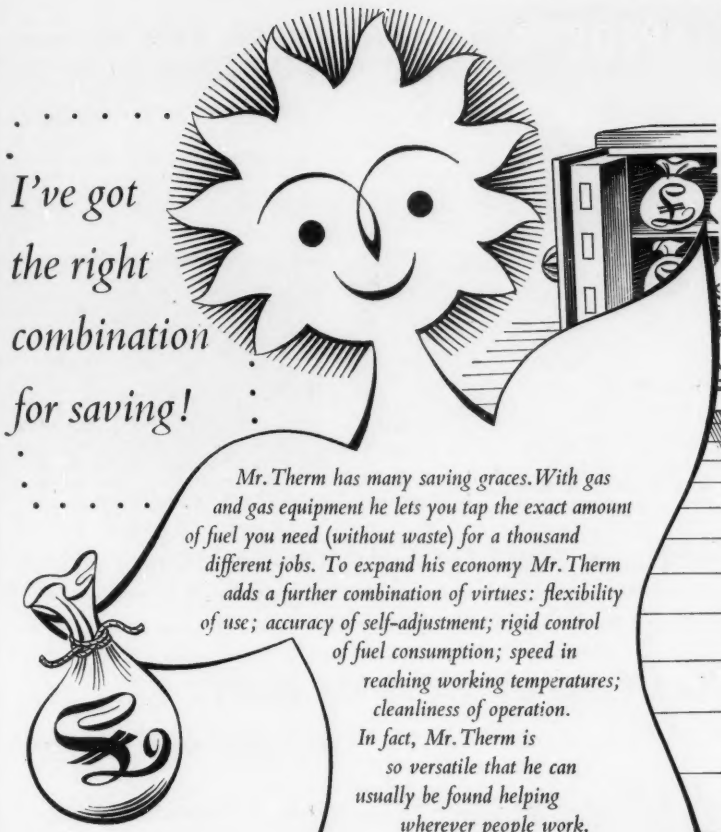

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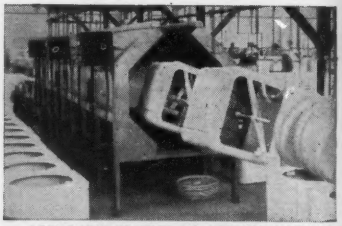

ACKNOWLEDGEMENT TO BRITISH VACUUM CLEANER & ENGINEERING CO., LTD.

NEIL & SPENCER GAS APPLIANCES SECTION

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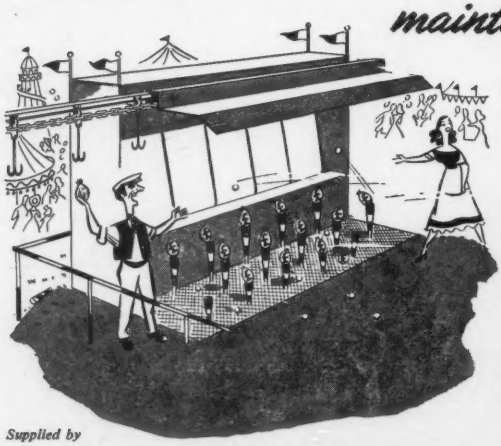
Knock down those spray booth maintenance costs!



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the water conditioning agent for "de-stickyfying" over-spray paint.

'PULTAC'

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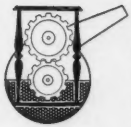

Polykem, the brilliant quartet of industrial finishes based on Berger-developed styrenated alkyds, proves its superiority in the way that means most—it raises sale figures. And, equally important, each air- or stove-drying Polykem finish possesses a technical efficiency that cuts costs all along the line. Polykem finishes dry faster. They have the smoothest, easiest flow, the longest lasting gloss, the firmest adhesion, *the most remarkable economy*. If you would like to hear more, send a postcard—mentioning your manufacturing interests—to the address below for details of the application of Polykem Industrial Finishes to your particular products.

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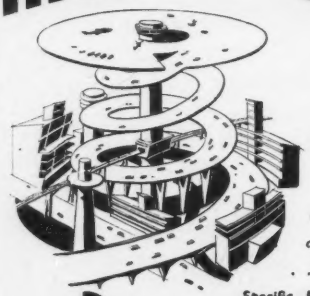

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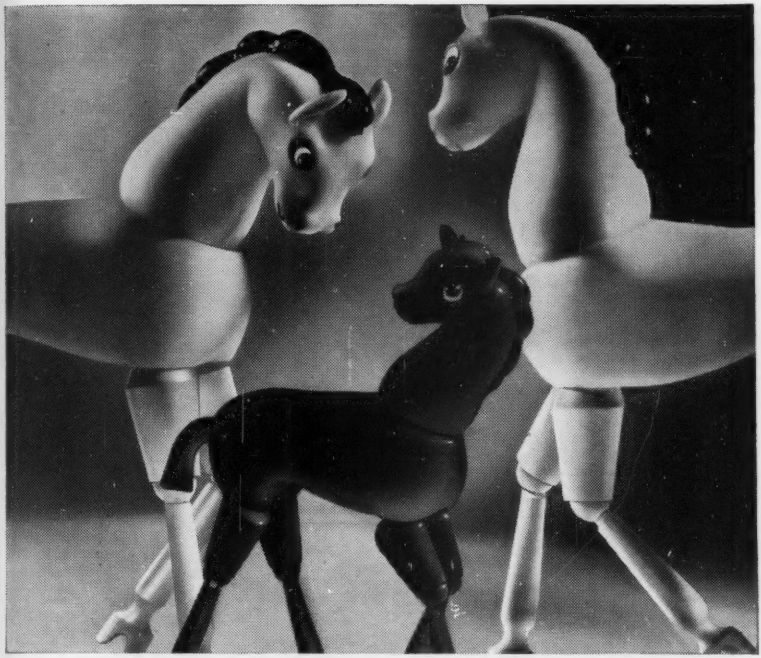

A HORSE OF A DIFFERENT COLOUR

EVERY FAMILY has its own problems, but you'll find — much as our friends-on-the-hoof here did—that generally speaking. "problems" are never as black as they're painted. And speaking of paint (we invariably do, of course!) the chances are that you've got a finishing problem to solve right now, or will have at some time in the future. You're saved in either event if you remember CELLON. The Cellon technical staff have already supplied the answers to most finishing headaches, as is evidenced by the wide variety of paints and finishes produced in the Cellon factories. For Wood Finishing — the superb Cerric range; for Transport, Building and Marine—the renowned Cerrux range; AND FOR INDUSTRY—specially formulated finishes by Cellon with carefully balanced drying schedules to meet the specialised requirements of mass production.

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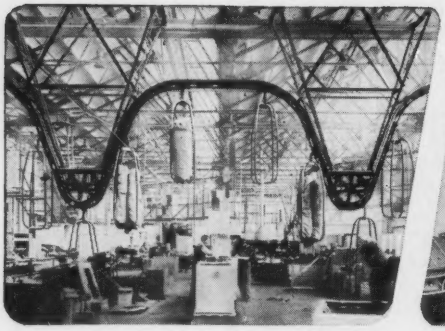
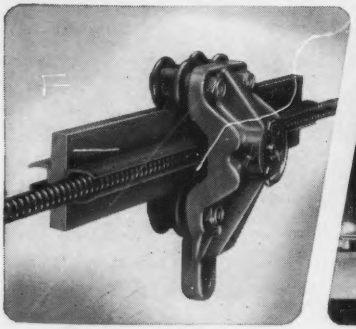
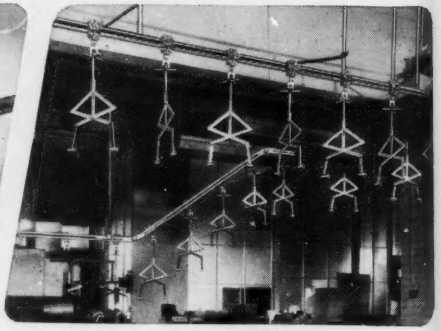


TELEFLEX CONVEYORS



Top left installation photograph by courtesy of the Frigidaire Division of General Motors Ltd.



Lower right installation photograph by courtesy of A. C. Sphinx Sparking Plug Co. Ltd.

For "Medium Duty" Conveying—the chain conveyor shown in the top illustrations is designed to carry substantial loads. The principle of chain and guides is clearly shown in the top right inset, whilst adaptation to a platform conveyor is apparent from the lower right inset. For "Light-Duty" Conveying—the unique cable conveyor shown in the lower illustration. The inset illustration exemplifies the simple and sound construction used in manufacture.

Both the above types of conveyors are readily constructed from standard "off the shelf" units, which when assembled can form a "tailor-made" conveyor for your particular works. Inherent features of the Teleflex systems are, therefore:—

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Shell ketones

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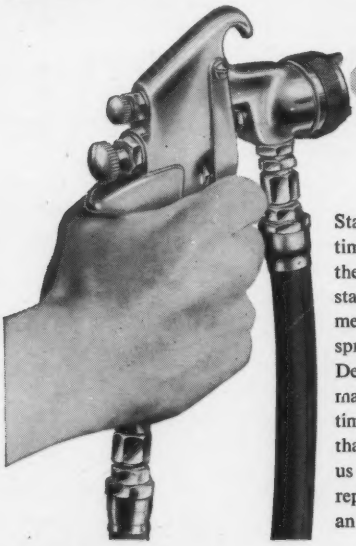

Standards in spray-finishing are rising all the time. And DeVilbiss-Aerograph are setting the pace today as they have done from the start. Whether it is small, light-weight equipment for girl operatives to use, or continuous spraying on large-scale mass production, DeVilbiss-Aerograph know just what factors make for efficient work. There are probably time and material costs on your own spraying that could be cut down further. Why not drop us a line (Dept. 21B), and let one of our representatives show you how to do it—with an improved finish into the bargain?

DEVILBISS *Sets the pace in spraying*

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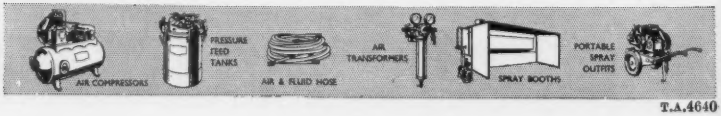

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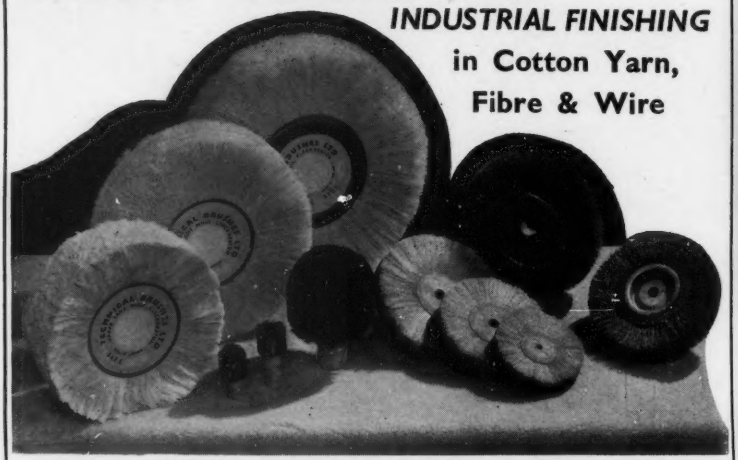

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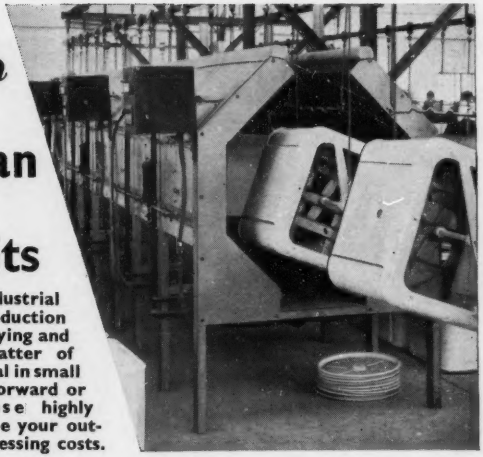

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Industrial Finishing

VOL. 5 SEPTEMBER, 1952 NO. 51

INDUSTRIAL FINISHING YEAR BOOK

THE issue of the first year book covering the finishing trades on the directory, buyers' guide and technical comment side, appeared under the above title in 1950. It was made freely available as part of the subscription to INDUSTRIAL FINISHING in order that it should have the widest possible readership and particularly as a relatively cheap form of supplying technical information to students and men engaged in the finishing trades who are appalled at the present cost of textbooks on the subject.

Its success was immediate and in each successive year the number of copies which are held in reserve literally disappeared like the snow in summer. Although each subscriber receives a free copy it is necessary to charge the nominal price of 15s. 6d. for *extra* copies, and it is always these extra copies which present a problem.

To avoid disappointment it is suggested that anyone requiring a copy of the new year book which, incidentally, has been very well reviewed in the past, should inform the publishers now, in order that they will be covered by the printing order about to be placed.

The idea behind this year book is that the normal contents are brought up-to-date each year and simultaneously about one-third of the editorial content is changed on the technical side so that as they are collected the successive issues will form between them a very comprehensive summary of available technical information on industrial finishing. Of course the directory, trade names and buyers' guide are all brought up-to-date each year.

The 1953 edition will contain upwards of 450 pages, of which 350 are devoted to technical information on cleaning, brightening, polishing, electroplating, metal colouring, aluminium finishing, finishing zinc alloys, the selection of paint finishes, wood finishing, paint data, paint application methods, paint testing, stoving, vitreous enamelling, metal coatings and miscellaneous technical data. In addition there is a complete list of all Government and British Standard specifications affecting the finishing trade with notes on relevant professional Institutes and Trade Associations.

Training in the Paint Industry

by ARGUS

BROWSING through *Official Digest* —the organ of the American Federation of Paint and Varnish Production Clubs—for July, one notices that their Educational Committee is very active regarding recruitment and training of young people for the paint industry. Among their responsibilities may be included the encouragement of continuous training of paint men—the fostering of educational projects—the assistance of educational institutions in both establishing and conducting courses in paint technology as well as the collection and distribution of information on educational matters relating to surface coatings. The Committee has also concerned itself with research.

Accomplishments

Among its accomplishments has been the increase in the number of educational institutions giving courses in paint technology—there were seventeen such higher institutions giving between them forty-five courses in different aspects of paint technology during 1951-2. The Federation has established a Fellowship at the Illinois Institute of Technology—they have persuaded industrial concerns to allocate scholarships and fellowships. They have compiled a model book on paint technology as a vocation, directed at attracting outside students into the industry—they have initiated a short course on drying oils at the University of Minnesota.

The above points are mentioned not so much in the sense that they should be copied in Britain, for the status and position of universities and technical colleges in the U.K. differ considerably from America. The point is, however, that this Federation is doing something really positive towards attracting students to the American paint and varnish industry.

In Britain one must admit that the position is far from satisfactory. On the university side, only about three provincial universities deal with really technological subjects, and paint occupies a small part of their programme. Some of the technical colleges have initiated training schemes, but they are far from attracting the bright boy to the industry. Undoubtedly the lack of interest shown by manufacturers as a whole in realising that they must go out and fight for good recruits to their industry is due to the traditional age of paint in Britain. It is broadly two centuries old, but a generation ago it was still wallowing in the "recipe" stage with obsolescent plant and equipment. Although plants and equipment have tended to be modernised to give line production nevertheless the mentality of the senior executives of the industry was moulded and developed in the atmosphere of the "good old days."

Much to be Done

However, all industries are beginning to realise that they must go out and fight to attract the boys at school now to their industry, firstly by creating and demonstrating the interest value of the industry, and secondly by giving assistance to those who feel they would like to go into it. Although there has been 25 years of research and development in paint, there is still much work to be done, many plants to be modernised and newer problems of finding newer, different and available raw materials. During 1939-1945, many of our industries realised how we had failed to make the best use of indigenous products, relying entirely upon importations from thousands of miles away, which were virtually cut off at the peak of the submarine menace. The production of surface coatings from

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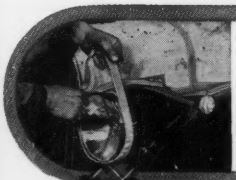

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home materials is of first-rate importance.

Also, the paint technologist finds himself brought into practically every major industry because practically every article, no matter how complex or simple, is constructed from a material which soon rusts or deteriorates without a finishing coat.

There is need for somebody representing the paint industry to make overtures to the schools and technical colleges with films, prepared lecture notes, to arrange works visits and so on, deliberately aimed at stimulating the interest of the boys of 15 plus in the paint industry. Other industries are doing this—ample evidence is available in coal, gas, electricity, and gauge and tool makers, and so on. Those industries which make this concerted effort first will reap a rich crop in the next 10 to 15 years. Those industries which do not will find that they are constantly handicapped by the absence of high calibre entrants, which cannot help but have a reactionary effect upon the progress.

Therein lies a problem—in America some real effort is being made. Enthusiasts in Britain are likewise making real efforts, but these efforts are not co-ordinated and correlated. In the interests of the paint industry, which, when one considers application, pretreatment and paint, is a £240,000,000 industry, some really definite scheme must surely be undertaken.

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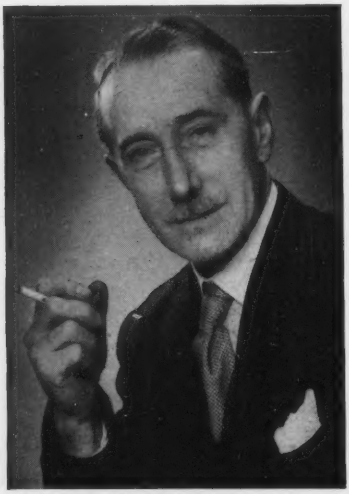

Mr. J. C. Hanna

War-time service found him in the first boat at the Suvla Bay landing at Gallipoli—he was not one of the 100,000 casualties, but earned a well-merited mention in despatches. Returning, he went back to his old firm in their London office, in the publicity and export department when, as he says, orders were few and far between, averaging only half-a-dozen a month. A year or so later he returned to Newcastle in the same job. He it was, that began the Apexior department, and he was appointed general manager of both the export and Apexior departments in 1935. Now he is responsible as general manager for the whole of the British Paints Sales Organisation.

Above all, John C. Hanna is an enthusiast—once he believes that he is on the right line, he will hang on to that approach relentlessly. He is another example to the younger members of the paint trade as to what can be done with knowledge, drive and determination.

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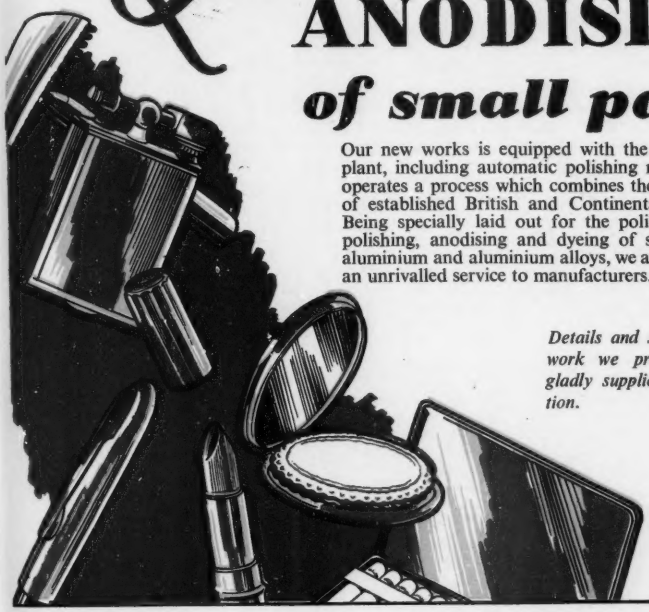

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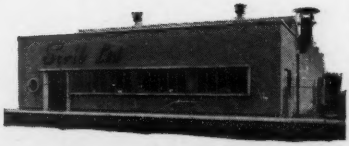

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Prevention of Machinery Corrosion

THE following notes are not intended to substitute for works of reference on corrosion, least of all on those aspects of corrosion such as that in plant in chemical works or in fluid systems of any kind. Such aspects of corrosion, as well as direct oxidation at high temperature, are the subjects of special studies. The suggestions given below are intended rather for the consideration of designers and engineers concerned with general machinery subjected to ordinary conditions of exposure.

Selection of Materials

It is, of course, always desirable that engineering metals should be able to resist progressive corrosion, and for certain purposes resistance to corrosion is of critical importance. Many corrosion-resistant alloys, including particularly chromium-nickel steels and other "stainless" steels and types of cast iron, are available. In selection of metal, however, many considerations other than corrodibility have to be taken into account. Cost, suitability for treatment such as working, casting and machining, also mechanical strength and so on, are generally important, and often electrical properties or other special features must be considered. For many purposes in engineering generally, high intrinsic resistance to corrosion in ordinary environments is not essential and has to take second place to vital requirements such as availability in large quantities at low cost. This

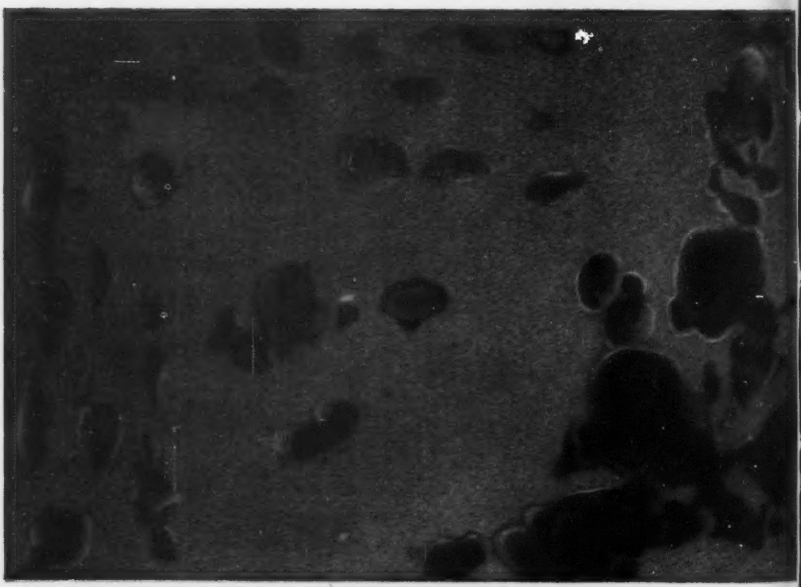
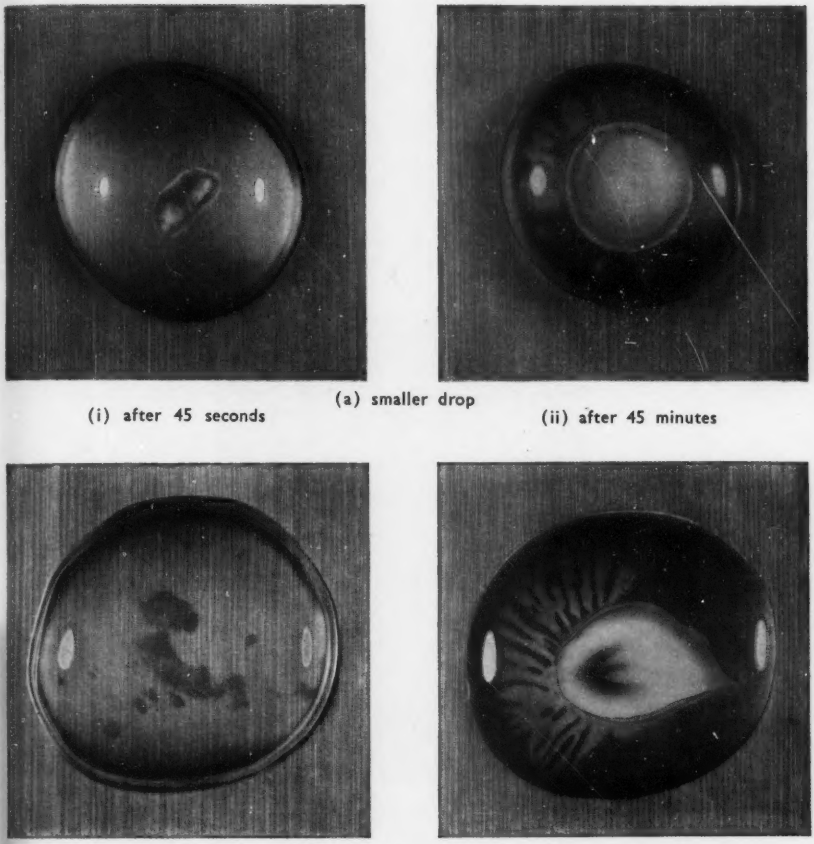


Fig. 1. Distribution of Corrosive Attack



(a) smaller drop

(i) after 45 seconds (ii) after 45 minutes

(b) larger drop

(i) after 45 seconds (ii) after 45 minutes

Fig. 2. Corrosion by drops

applies particularly to plain carbon steels and other ferrous metals except the stainless alloys. For some purposes it is economically worth while to include small quantities of more expensive metals in steel used on a large scale, to obtain some improvement in corrosion resistance; in particular, addition of 0·2 to 0·5 per cent. copper to structural steel improves resistance of the metal to atmospheric attack. Even so, the common ferrous metals are outstanding in their susceptibility to electrochemical corrosion.

Where the electrolyte is provided through hygroscopic action of substances on the metal surface, or through the presence of isolated patches of dampness on the metal surface, electrochemical attack will be local and unlikely to involve couples of dissimilar metals of different components. If, however, quantities of moisture are present in pockets or as relatively thick surface films, corrosion may be intensified by contact between components of dissimilar metals. Where such conditions are liable to arise, some scope exists for selection

of metals so as to avoid unnecessary increase in the severity of corrosion liable to occur. Combinations of metals differing considerably in electrode potential should, in general, then be avoided. For guidance in this matter galvanic series representing the behaviour of metals and alloys in natural electrolytes should be used instead of the electrochemical series. An abridged series of the type suitable is given on page 113. Metals between which there is not a large difference of electrode potential in natural salt solutions are grouped together. Coupling of metals of widely separated groups is liable to cause severe anodic attack.

If combination of metals of widely different electrode potential is unavoidable, it may be desirable where possible to separate the metals by electrical insulation; for example, insulating washers and sleeves might be used where bolts made of one metal pass through a second metal. Such insulation is particularly often desirable where magnesium or aluminium, or alloys of these metals, are used. Insulation should not be of hygroscopic material such as certain types of impregnated paper. If complete insulation is impracticable, coatings of a suitable primer such as one pigmented with zinc chromate may be used to increase the resistance of the circuit.

Experience shows that galvanic attack is especially likely to occur at threaded connections between dissimilar metals. Where such threaded connections are unavoidable, especial care should be taken to exclude moisture.

Under severe conditions, approaching those of immersed corrosion, a particularly dangerous combination is that of a large cathode and small anode, since the rate of attack on the anode is independent of its size where the reaction is under cathodic control. A classical example of rampant galvanic attack is that of a small vessel, built in 1915, in which steel rivets were used in a Monel metal hull. Monel metal is highly cathodic towards steel; the result was that severe anodic attack on the steel rivets took place, the corrosion being under cathodic control. Although it is frequently out of the question to substitute materials of higher electrode potential for ferrous metals or others susceptible to anodic attack, such substitution may be practicable where the components concerned are relatively small.

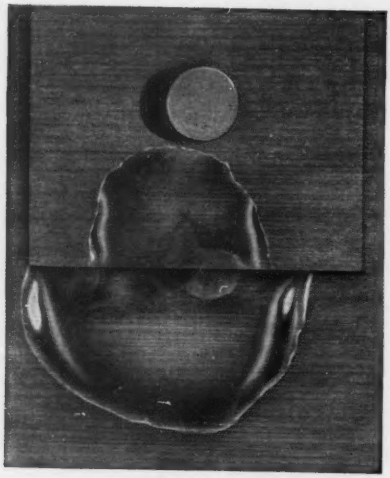


Fig 3. Crevice attack—I

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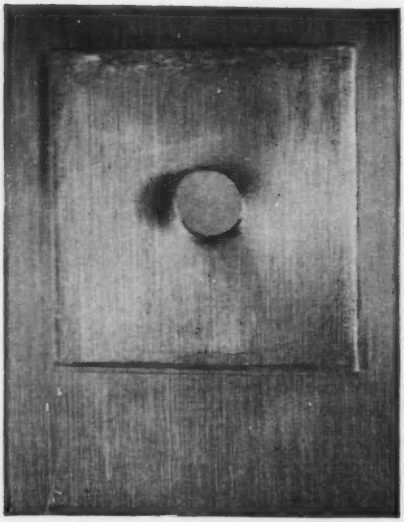
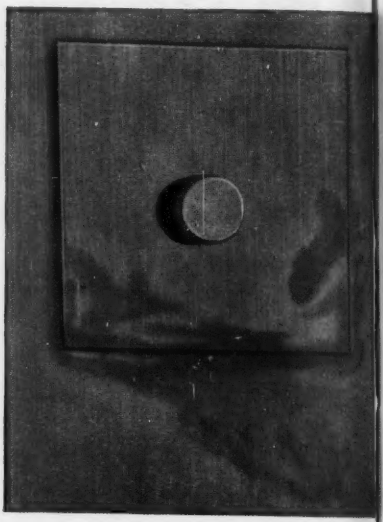
the results are shown in Fig. 6, conditions of large cathode/small anode were contrived artificially. Very heavy attack on the narrow band of exposed metal took place on the unprotected plate.

Crevices

Whenever a machine is exposed to a moist atmosphere, condensed water tends to find its way into crevices of any kind in static components, and remain there more or less indefinitely. Persistent pockets or films of moisture are particularly liable to form in



(a) Test-piece coated with Shell Ensis Fluid 260, after de-greasing



(b) Unprotected test-piece

Fig. 4. Crevice attack—2

crevices between different components, and if these are of different electrode potential galvanic attack is especially likely to result. Conditions may then also favour development of a differential-aeration cell, or one due to difference in concentration of dissolved salts between one point and another. Corrosion in crevices is especially objectionable for the reason that the products of corrosion are usually of much higher specific volume than the metals from which they are derived, and their formation in confined spaces may therefore set up considerable pressure. The consequences are liable to be extension of corrosion along small cracks in the metal surfaces, followed by structural damage. (Rivet heads may be snapped off through weakening and overstressing in this manner.) Wherever possible, therefore, crevices should be avoided or sealed.

Figs. 3 and 4 show crevice attack by neutral salt solutions on austenitic stainless steel.

Every method of preserving corrodible metal is designed to interfere in some way with the mechanism of the type of corrosion that would otherwise be liable to occur. It is for this reason that a working knowledge of the general mechanism of corrosion is necessary to an appreciation of the limitations and special advantages of each of the many protective measures that may be put into effect. These measures naturally vary widely in their fields of application, according to practical conditions. In the case of buried or submerged corrosion, for example, metal surfaces can often be

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provided with effective protection by deliberately arranging a galvanic cell in which the surfaces to be protected are made cathodic and sacrificial corrosion occurs at a specially introduced electrode (anode) of lower electrochemical potential, the anode being renewed when consumed. Sometimes such "cathodic protection" may be afforded by means of a counter-e.m.f. supplied by an external source of current. Another kind of preventive measure, used widely in closed systems containing water, is the use of inhibitors to increase polarisation of anode or cathode, thereby reducing the galvanic current. An instance of this is the addition of chromates or phosphates to aqueous systems to protect steel by impeding the anodic process.

By far the most common method of preventing corrosion is the application of an adherent impervious coating to the corrodible metal, to insulate it from its environment.

The coatings used on metal surfaces to prevent corrosion vary from a permanent layer of a metal such as tin to a removable film of a petroleum product. Generally speaking they may be classified as follows:

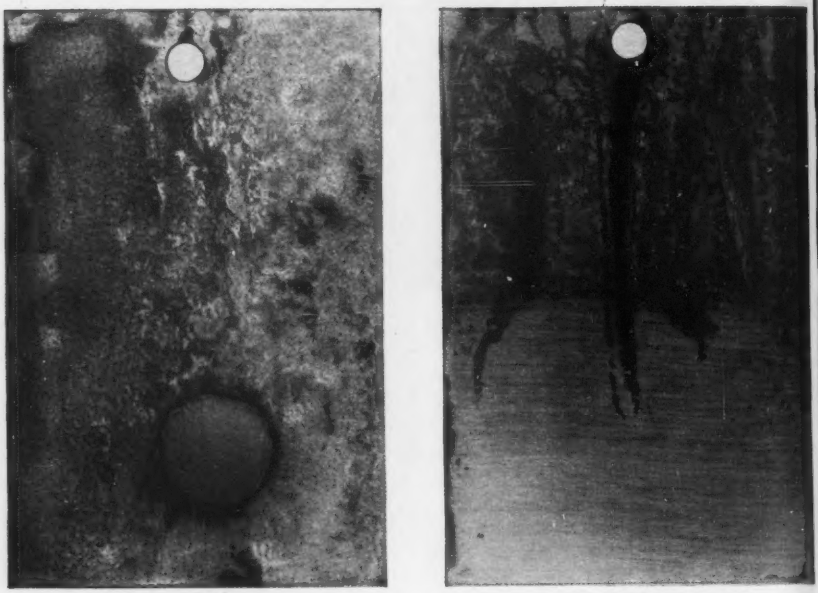
1. *Metallic Coatings.* — By various processes, layers of metals—chromium, nickel, zinc, aluminium and so on—are deposited on the base metal. These metals are chosen because (*a*) they are intrinsically less corrodible than the base metals in the environments they are required to meet, or (*b*) because under given conditions they form corrosion-resistant films on their surfaces, or (*c*) they suffer sacrificial corrosion. Methods of application include:

   Electrodeposition: electrolytic plating.

   Hot-dipping: the article is dipped in a bath of molten metal such as zinc or tin.

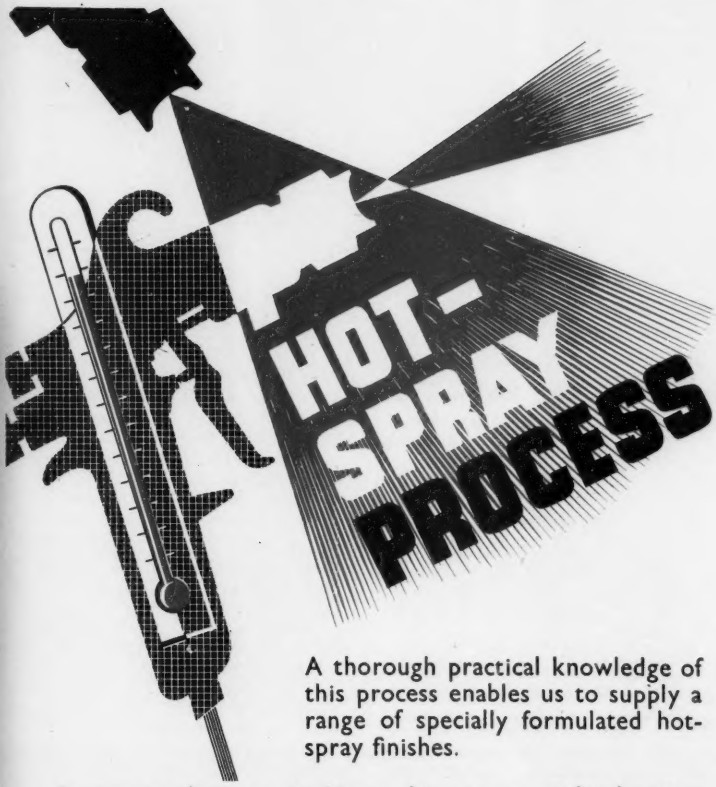
   Cladding: a veneer of the protecting metal is rolled or drawn on to the metal to be protected. For example, pure aluminium is rolled on to aluminium alloy.

   Surface diffusion: the article is



(b) Steel Copper couple (a) Steel Zinc couple

Fig. 5. Corrosion couples due to incomplete metal coatings.



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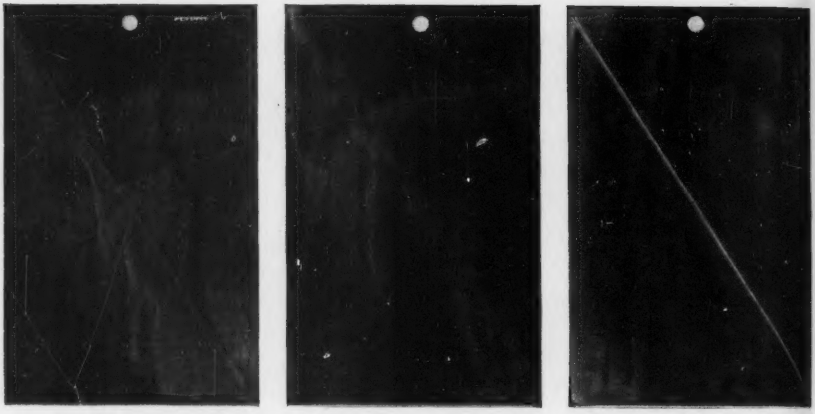


(a) Unprotected plate

(b) Plate coated with mineral oil

(c) Plate coated with Shell Ensis Fluid 256, after degreasing

Fig. 6. Comparative test of protectives—1

heated in contact with the protecting metal, which is in powder form. The melting point of the powdered metal is not reached.

Metal-spraying: molten particles of the coating metal are sprayed on to the base metal from a pistol.

Fig. 5 illustrates corrosion couples formed by mild steel and incomplete metal coatings. In Fig. 5 (a) the coating (zinc) is of the type that suffers sacrificial attack when the underlying steel is exposed. In Fig. 5 (b) the coating (copper) is intrinsically less corrodible than mild steel and will not suffer sacrificial attack.

2. *Conversion and Similar Coatings.*—This group includes especially the insoluble oxide coatings produced on aluminium and its alloys by electrolytic means. The coating adheres tenaciously to the metal surface and confers a considerable degree of protection against corrosion. Similarly, coatings such as chromates, phosphates and so on are produced by chemical and electrolytic methods on other metals, particularly zinc, magnesium, iron and so on, as well as on aluminium. These coatings are, however, mostly used as bases for paint.

3. *Paints and Similar Coatings.*—In most conventional types of paint system for the protection of metals the first coat ("primer") includes pigments intended to inhibit any corrosion that might take place as a result of penetration of the paint film by moisture. The film provided by the first coat may not itself be very resistant to penetration by moisture, but subsequent coats, which do not need to contain a corrosion-inhibitive pigment, are generally designed to offer the greatest possible resistance to moisture, so protecting the primer. Some paint-type coating systems rely purely on ability to prevent access of moisture to the metal and do not contain a corrosion-inhibitive pigment.

4. *Temporary protectives.*—These are corrosion preventives, mostly petroleum-base products, that can readily be removed from metal surfaces by wiping or by application of common petroleum solvents. Their main field of application is the protection of working surfaces of machinery.

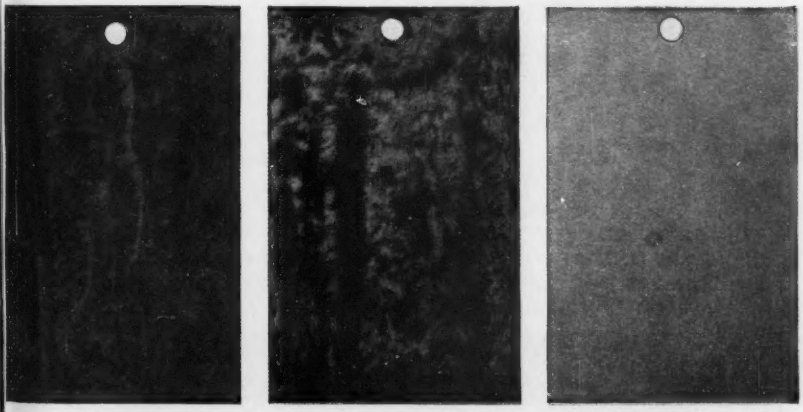
The selection of permanent coatings and the methods of applying them are the subject of a very full literature and outside the scope of these notes. However, an important consideration

to be borne in mind in the temporary protection of machinery subjected to severe conditions of exposure arises from the study of the electrochemical theory of corrosion and may be mentioned here. It is obviously desirable to provide corrodible metal surfaces with a suitable protective film, but the desirability of coating the surfaces that do not corrode is apt to be overlooked. If only anodic components of a machine are so covered, and the film is subsequently damaged or breaks down locally, the possibility exists that concentrated attack may occur at the small exposed anodic areas, through combination of large cathode/small anode. This is likely to happen in the vicinity of components of relatively cathodic metal, since it is possible for a continuous layer of water to extend, over the protective film, from the anodic areas to the cathodic metal. The best way to provide against such intense attack is to coat the cathode as well as the anode. If, for example, a machine has components of gunmetal or Monel metal attached to steel, the gunmetal or Monel should be coated also, at least in the vicinity of the junction with the steel. (This is not always practicable with parts of electrical machinery such as armatures, but such equipment has to be kept dry anyway, since the insulation must be preserved from dampness.)

If finished machinery has to be, say, left in the open, or otherwise exposed to corrosive conditions for a lengthy period, it is worth while from time to time to examine protective coatings and repair them as necessary, but to take especial care of coatings on surfaces near junctions between different metals. In such regions local breakdown of the protective films on the anodic metals is particularly dangerous.

Fig. 1 illustrates the characteristic distribution of corrosive attack on ferrous metals under ordinary conditions, whereby the anodic areas tend in general to be sharply defined and isolated from each other. It shows a horizontal mild-steel panel approximately 5 min. after being coated with a film of aqueous salt solution (N/10 potassium chloride) containing a small amount of potassium ferricyanide. Where ferrous ions go into solution they react with potassium ferricyanide to form an iron salt giving the well-known "Prussian blue" coloration; thus the blue areas are those where the anodic reaction is in progress.

Fig. 2 shows the characteristic form of corrosive attack caused by drops of natural water, i.e., vigorous attack on a central zone of limited area, with precipitation of rust on an annular belt between the central and peripheral zones. This is attributable to differential aeration, i.e., the drop



(a) Unprotected plate

(b) Plate coated with mineral oil

(c) Plate coated with Shell Ensis Fluid 256, after degreasing

Fig. 7. Comparative test of protectives—2

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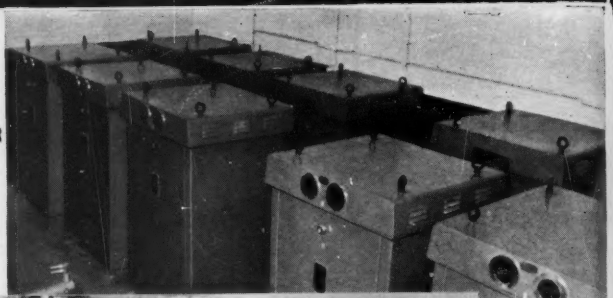

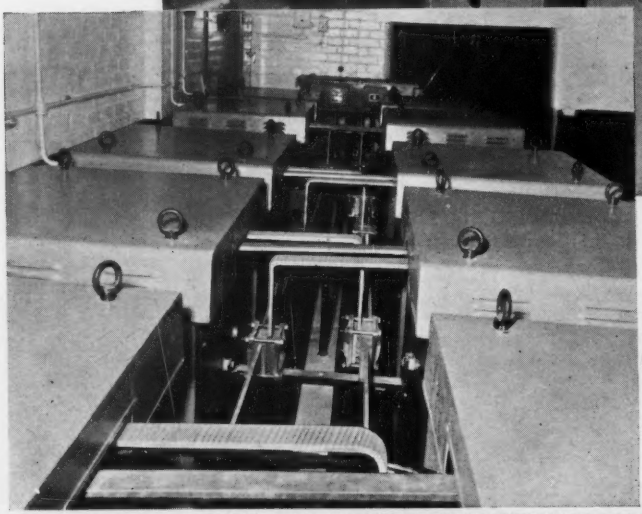

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forms a concentration cell in which oxygen is readily available at the outskirts, which therefore tend to become cathodic, but is less readily available at the centre, which tends to become anodic. In smaller drops the differential availability of oxygen is more pronounced and the attack consequently develops more rapidly and is more highly concentrated. In larger drops corrosion begins at several scattered points and persists elsewhere than at the centre until the oxygen immediately available within the body of the electrolyte is used up. Subsequently the attack follows the course of that in the small drop, though more slowly.

The drop shown here consisted of aqueous salt solution (N/10 potassium chloride) containing small amounts of phenolphthalein and potassium ferricyanide. Each drop was placed by a pipette on a horizontal mild-steel plate. That of Fig. 2 (a) was approximately 0·4 in. across, and that of Fig. 2 (b) approximately 0·8 in. across. The plates had been cleaned by abrasion with fine emery paper followed by degreasing.

As mentioned in relation to Fig. 1, potassium ferricyanide reacts with ferrous ions to produce an iron salt shown by "Prussian blue" coloration. Phenolphthalein reacts with hydroxyl ions to form a red product. As corrosion proceeds in the drop, therefore, blue coloration should appear where the metal surface is anodic, and red where it is cathodic. Fig. 2 (a)—(i) shows the smaller drop after about 45 secs. A distinct area of Prussian blue has appeared in the centre. Fig. 2 (a)—(ii) shows this drop after 45 min. The peripheral zone is now clearly red, and between this area and the centre a yellow rust is visible. These effects show that the inner zone is anodic and the peripheral zone cathodic.

Fig. 2 (b)—(i) shows the larger drop after about 45 sec. In this drop an irregular blue pattern is seen at this stage, showing that the reaction has begun with a number of scattered areas of anodic activity. Later, however, attack on the metal became confined to the centre. Fig. 2 (b)—(ii) shows the same drop after 45 min. The reaction has followed the same course as before.

The reason why the blue coloration became pronounced first in both drops is that the anodic activity is concentrated at limited areas, and the anodic indicator produces a precipitate, whereas the cathodic activity is dispersed over a wider area and the indicator product is water-soluble. In both cases the anodic and cathodic reactions must, however, of necessity have commenced simultaneously.

GALVANIC SERIES OF METALS IN NATURAL SOLUTIONS

Cathodic (Electropositive) ↑

(Graphite)

Stainless steel (passive)

Monel metal

Silver solder

Gunmetal
Cupro-nickel
Copper
Brasses; aluminium bronze

Nickel

Manganese bronze

Tin
Lead
Lead-tin solder

Stainless steel (active)
Cast iron
Steels, except stainless

Cadmium
Aluminium alloys
Aluminium

Galvanised steel or iron
Zinc

↓ Anodic (Electronegative)

Magnesium alloys
Magnesium

The above list is not intended to give more than a general indication of the couples to be especially avoided. Depending on the conditions to which the metal is exposed, some changes in the relative positions of metals in the table are to be expected. (Stainless steel is usually passive in natural electrolytes, except where its area is relatively small.)

Fig. 3 indicates that corrosion may be due to the existence of a crevice. It shows part of a specially prepared composite test-piece made up of one plate, 0·028 in. thick and approximately 0·75 in. square, riveted to a second plate of the same thickness but of greater area. The two pieces of

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plate and the rivet were all of the same material, an 18/8 (18 per cent. Cr/8 per cent. Ni/0·12 per cent. C) austenitic stainless steel. This steel will not normally suffer corrosive attack by neutral salt solutions. The corrosive activity shown to have commenced in this case is attributable to the existence of a concentration cell associated with the crevice and probably due to differential aeration.

The test piece was placed horizontally, and a drop of aqueous salt solution (N/10 potassium chloride) containing a small amount of potassium ferricyanide placed on the edge of the smaller plate. Before application of the drop the test piece had been degreased. The photograph, taken after 4 min., shows the Prussian blue coloration produced by potassium ferricyanide in the presence of ferrous ions, showing that anodic activity is taking place between the two plates where a very fine crevice, about 0·003 in. in width, existed over a limited area.

The test-pieces shown in Fig. 4 were similar to that of Fig. 3 and already described. Again the plates and rivets were all made of the same 18/8 austenitic stainless steel. The test-pieces were exposed together for 96 hours in a salt-spray cabinet. Test-piece (a), protected by a coating of Shell Ensis Fluid 260, is shown, after degreasing, to have been unaffected. Test piece (b) has suffered crevice attack.

Fig. 5 (a) illustrates sacrificial corrosion. It shows a galvanized steel plate from which the zinc coating was first removed over a circular area approximately 0·5 in., in diameter. The plate was then exposed for 120 hours in a salt spray cabinet. The exposed steel has formed the cathodic member of a couple and has thereby escaped corrosion at the expense of heavy attack on the zinc, the anodic member. Some extension of the area of steel exposed has, however, taken place, and attack on the steel would eventually have followed when the exposed area became large enough for the central area to be too far from the zinc to be protected by it.

Fig. 5 (b) shows a couple formed by copper-plating half the area of a mild steel panel by electrolytic deposition in a cyanide bath. The couple was exposed for twenty-four hours in a salt spray cabinet. Copper alone would normally have become dull on such exposure, but in this case the copper has remained bright. This is attributable to its juxtaposition with steel, towards which it is cathodic. The steel beneath the copper has, of course, enjoyed complete protection, but accelerated attack on the exposed steel has taken place.

Each of the mild-steel test pieces (Fig. 6) 3 in. by 2 in. in area, was first given an oxide film by heating to redness for 5 min., then being allowed to cool in the air. The oxide film (scale) was then removed over a diagonal strip approximately 0·04 in. wide, to produce the conditions of large cathode/small anode. Plate (b) was coated with straight mineral oil, and Plate (c) with Shell Ensis Fluid 256. Plate (a) was left unprotected. The straight mineral oil used on Plate (b) was of high viscosity (81·5 cs. at 140° F.), so as to obtain a thick, tenacious film.

All three plates were exposed together for sixteen hours in a salt spray cabinet. Apart from the comparative results of the test, the great extension of the area of attack in Plate (a) (through undermining of the scale) is of note.

The panels (Fig. 7) of clean, planished mild steel, 3 in. by 2 in. in area, were exposed together for 8 hours in a salt spray cabinet. As before, Plate (a) was unprotected, Plate (b) was coated with straight mineral oil of viscosity 81·5 cs. at 140° F. and Plate (c) was coated with Shell Ensis Fluid 256.

This article was extracted from a publication entitled "Corrosion and Temporary Protectives" published by the Shell Petroleum Co. Ltd. The whole book is a most useful dissertation upon corrosion. It deals with the mechanism of corrosion, the atmospheric corrosion of engineering materials as well as the use of temporary protectives, which are classified. Notes are given on their application to both external and internal surfaces with examples relating to specific assemblies. Further information is provided on their removal as well as test procedures. The booklet closes with physical and chemical data relating to the well-known Shell "Ensis" series of protectives.

The article and illustrations are reproduced by permission and co-operation of the Shell Petroleum Co. Ltd.

TECHNOLOGICAL COURSES

THE Northampton Polytechnic, London, E.C.1, announces details of their part-time courses in technological subjects. Among these courses are the the following: a metal finishing operatives' course which provides a theoretical basis for those craftsmen engaged in the metal finishing trades. It extends over three years and at its conclusion students will be able to sit for the City and Guilds of London Institute examination "17a, Operatives' Course in Metal Finishing." There is another metal finishing course covering a wider and more advanced field suitable for the preparation of students for the City and Guilds of London Institute examination in the subject "Metal Finishing, including the Electrodeposition of Metals." The course extends over six years, the intermediate examination being taken at the end of the fourth year and the final at the end of the sixth.

There is a fuel technology course suitable for preparing students for the City and Guilds examination conducted for the Institute of Fuel.

There is a course in glass blowing suitable for chemistry students and laboratory technicians as well as a course for glass technology of which the syllabus is specifically directed towards those engaged in the glass working trades. A course in clay technology is suitable for those engaged in the heavy clay industry, including brick, tile, pottery and refractory sections. Many of these courses are repeated as evening courses and an additional evening course on boiler house products prepares students for the City and Guilds' examination.

A course of evening lectures on "Refractories, their manufacture, properties and uses" begins on 30th September, 1952, at 7 p.m. Those interested should communicate direct with the Secretary, Northampton Polytechnic, St. John's Street, London, E.C.1.

A Modern Electro-galvanizing Process

by

A. E. WILLIAMS, Ph.D.,F.C.S.

REPRESENTING a considerable improvement on the time-honoured electro-galvanizing process is the "BRyanising" method for the coating of wire. It is essentially a process for the continuous electro-galvanizing of wire, whereby a coating of high-purity zinc is bonded perfectly to steel wire to impart superior resistance to corrosion. Although the necessarily expensive plant was first installed by the Bethlehem Steel Co., U.S.A., the process was the invention of the late Dr. U. C. Tainton, a British subject and graduate of Manchester University, who achieved an international reputation as a metallurgist and electro-chemist.

In 1938, the British rights were acquired jointly by British Ropes Ltd., and Rylands Bros.; the former company operating the process at two factories, in Doncaster and Retford respectively. The continuous aspect of the process means that each length of wire keeps travelling forward until the whole range of operations has been completed. The plating cells at the two factories are 94 ft. and 104 ft. long respectively, and the cells

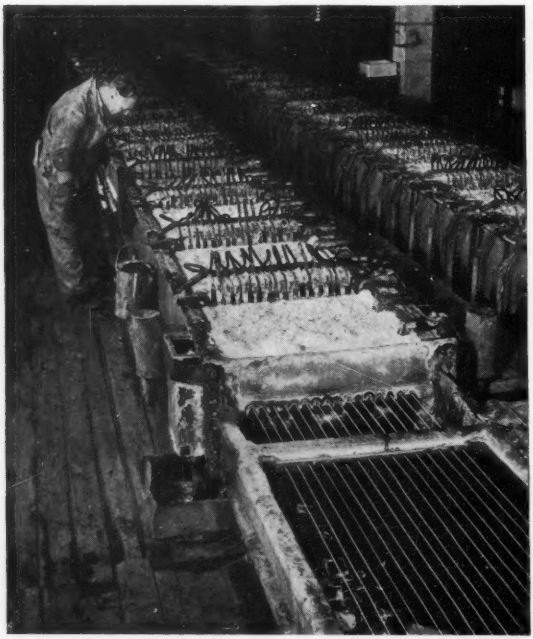

Fig. 1. Plating cells used in the "BRyanising" process for the electro-galvanizing of wire. Sixteen lengths of wire are treated together

(*Courtesy: British Ropes Ltd.*)

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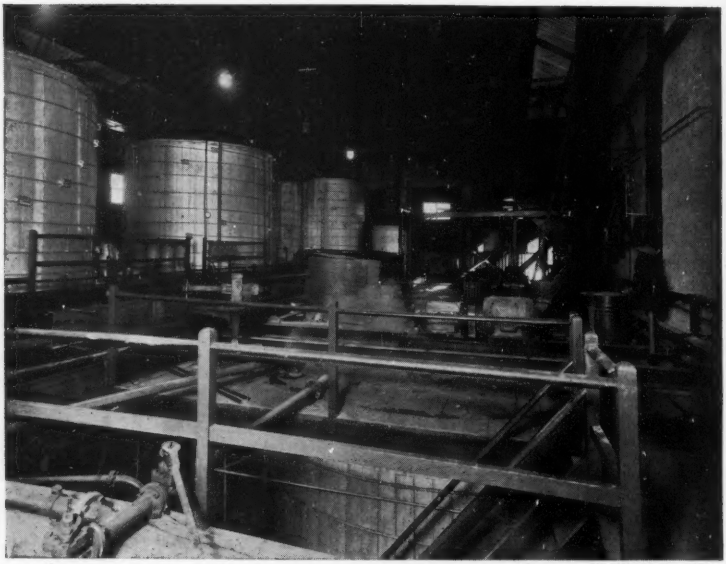
operate in groups of four, located side by side.

Superficially, the construction of each cell, Fig. 1, is simple. It can best be likened to an elongated water-trough of iron with a hollow lining of lead; the space available being used as a water jacket to cool the electrolyte, because the temperature of the latter must not rise above 100° F. Instead of employing soluble anodes which are consumed as the process proceeds, the anodes in each cell in this particular plant, are strips of silver-lead alloy which are insoluble and unaffected by the process. The zinc deposited on the wire is drawn entirely from the electrolyte. Each length of wire passing through a cell, being electrically charged, necessitates porcelain guides being employed. Sixteen lengths of wire are always passing through each cell simultaneously, on parallel courses; and on each wire rides a series of cathodes equally spaced from each other. These cathodes are arranged in relays along each cell.

Power for the plating process is provided by a special power house which, at the plant with 94 ft. cells is equipped with seven generators delivering direct current at 20 volts, 35,000 amps. The cells operate in groups of four, the main current at 20 volts being supplied to each cell at 5 volts. Cathodic current is passed through a busbar system, from which riser bars carry it to the cathodes. Amperage per cathode is 80 at the entry end of each cell, and drops to between 50 and 60 at the delivery end. The success of the process is largely due to the fact that the electrolyte—an acid solution of zinc sulphate—can maintain a deposit of zinc of 99·999 per cent. At the delivery end of each cell, the wire emerges with as pure a coating of zinc as is at present industrially possible to attain.

Several intricate devices have contributed to this result. For example, the wire is caused gently to rotate throughout its passage through the cell, to promote the equal "striking"



(Courtesy: British Ropes Ltd.)

Fig. 2. Leach house, showing vats in which the electrolyte is prepared

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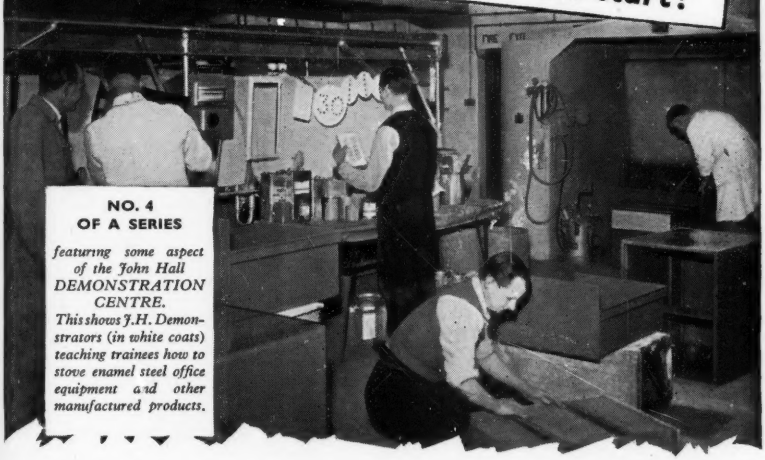

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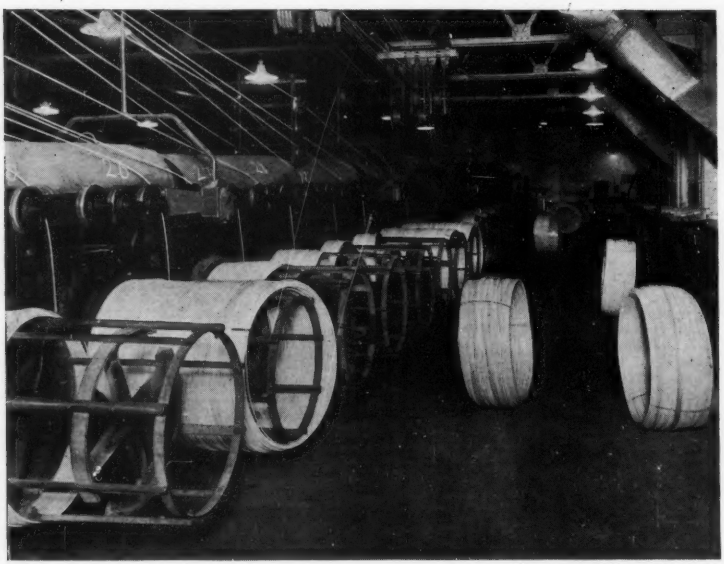
or deposition of the plating around the surface of the wire. The speed of travel through the cell is controlled by the winding machine, which provides the motive power for the wire from the time it is paid off the swifts to the final coiling. Apparatus is installed accurately to determine the rate of deposition, and the speed of travel regulates the weight of zinc deposited per sq. ft. of wire surface. A given amperage per hour is equal to a specific weight of deposit, other factors being standardised. The acid are the chief ingredients of the electrolyte; the ore being added to the acid in heated vats, Fig. 2, until the resulting liquid is neutral. The iron impurities are precipitated with powdered manganese dioxide, cadmium, cobalt, nickel, copper, etc.; the impurities being similarly removed later by the addition of powdered metallic zinc.

A filter press removes the precipitate from the electrolyte and the extremely pure solution that results is stored and then constantly added to



(*Courtesy: British Ropes Ltd.*)

Fig. 3. Coated wire on coiling frames before drawing to final size

operators and maintenance men in the plant have to be acquainted constantly with the state of the plant so that any disturbance of the normal process may be immediately rectified. For this purpose a diagrammatic control panel is installed, and shows by coloured lights which section of the cells are "on" and "off"; while instructions are also given to the operators through loudspeaker units.

The acid zinc-sulphate solution is prepared on novel lines. Roasted zinc ore in powder form is sucked into storage bins. This ore and sulphuric the main flow of the electrolyte in the plant to maintain the required zinc concentration. Forced circulation is employed, which also aids in keeping the temperature low. The emission of gas from the plating cells has to be controlled to maintain a clear atmosphere in the plant. This is done by introducing into the electrolyte a reagent which is inert to the plating process, and in effect a coating of froth over the electrolyte keeps the plant clear of fumes.

A feature of the process is that it enables coating to be done before the

wire is drawn down to its final diameter. Instead of being coated of necessity in the finished size, wire can be coated in the base size from which drawing starts, as is seen in Fig. 3. The necessary amount of deposit can be applied to give the specified weight of coating in the finished size to conform with B.S.S. 443. It is claimed that this method of coating gives the wire higher resistance to corrosion, while the coated wire lasts longer in specific service due to the high purity of the zinc. Because there is a tight bond between the steel surface of the wire and the zinc, there is no flaking or cracking of the coating. The latter is imparted to the wire in a very uniform manner, the zinc being of equal thickness all the way round. In this respect the process differs from older methods wherein such concentric coating is not always achieved.

The depth of coating can be easily controlled; any thickness up to 4 or 5 oz. per sq. ft. of wire surface can be produced. In contrast to this, hot-dip galvanizing is restricted to a maximum of approximately 1 oz. per sq. ft. The process also imparts a smoother surface to the wire than is possible by hot-dip galvanizing and because of this the treated wire causes less wear and tear to machinery, while it is easier to work and handle. Its semi-matt surface facilitates bonding to insulating materials and rubber in cable and hose armouring or when wires have to be painted. Where necessary, however, the wire can be given a polished finish. Compared with older methods of zinc coating, the process is rapid and coatings in conformity with B.S.S. 443 can be deposited in a little over 1 min., and as the coating is ductile, it withstands severe deformation without fracture.

CORONATION COLOURS

THE year 1953 will see another page of British history written, and this will be unique as far as colours are concerned, since it will be the first Coronation of a Queen as Sovereign since the discovery of synthetic dyestuffs by the Englishman Perkin in 1856.

The British Colour Council maintains an historical register of colours for ceremonial occasions, traditional dress and ancient customs of this country together with colour records of the services. Patterns of these colours will be available towards the end of August. These include colours of the Union Jack; bunting colours; tartan colours; colours of the most noble order of Knighthood; heraldic colours.

The range of traditional colours may be augmented by two or three different types for street decoration, but these will have to pass the test of sunshine and rain, and also have to be capable of living with, or harmonising with the traditional colours whose fastness is known.

Any further special colours will be announced later and any enquiries for ranges and decorative colour schemes for coronation colours should be addressed to The British Colour Council, 13 Portman Square, London, W.1. Welbeck 4185.

P.M.A.T.A. OFFICERS AND COUNCIL

THE new officers of the Paint Manufacturers and Allied Trade Association are : *President,* Mr. R. Lawson-Brown (Hudsons Paints Ltd.); *Vice-President,* Mr. W. H. Wilson (Rolls and Co. Ltd.); *Hon. Treasurer,* Mr. G. M. Taylor (Adshead, Ratcliffe and Co. Ltd.).

The elected members of council, now announced, are: Mr. R. E. Blyth (Blyth, Heald and Langdale Ltd); Mr. A. G. Bone (Paramount Paints Ltd.); Mr. D. C. Broonhall (Eldon Paint and Varnish Co. Ltd.); Mr. H. Davidson, Jnr. (The Eltham Paint and Varnish Co. Ltd.); Mr. R. B. E. Jackson (Silexine Paints Ltd.); Mr. H. C. Matthews (Henry Matthews and Co. Ltd.); Mr. N. Mayfield (Mayfield Bros. Ltd.), Mr. D. E. Roe (Paramount Paints Ltd.); Mr. G. E. Smith (Walter R. Taylor and Co. Ltd.), Mr. W. A. South (Redaluma Paint Co. Ltd.); Mr. E. Wilshire (Joseph Mason and Co. Ltd.).

Co-opted members of council are: Mr. C. R. Averill (C. R. Averill Ltd.) and Mr. A. E. Cooper (Nuodex Ltd.).

THE MAN ON THE JOB

by **"SERVICE MAN"**

ANY talk of cleaning metals must start with that little word of four letters—rust. There must be thousands of scientists who could talk and write about rust, its causes, its effects and methods of prevention, etc., for hours, days, weeks and years on end. Millions of money have been spent in the everlasting war upon rust—"red" or "white". The bulk of industrial finishing is a campaign against this enemy. Eventually, despite all the known methods of combat, rust wins in the end. Painted and plated articles that once shone, and were pleasing to the eye, end their days rusting away on the scrap heap.

Pre-treatment

What we can do is hold the rust at bay as long as possible, and this is naturally dependent on the type and quality of the pre-treatment. There are many rust-removing and rust-proofing systems in vogue and all have their merits.

The motor-car industry, for example, installs expensive plant for pre-treatment, yet the age-old trouble still remains. All car owners, in time, come to the original method when the edges of the doors, guttering and wings commence to go. Abrasive paper will always be the little man's chief weapon, plus or minus a propriety brand or home-made solution of neutralising acid. This is quite a good general system, always providing that the metal is not too bad and the degreasing is properly done. Sand or shot-blasting is well known but all things are not suitable for this type of rust removal.

Before leaving the subject of rust, I must mention a little phrase that was drummed, almost beaten into me, day after day, nearly forty years ago, in my apprenticeship days.

One of my first jobs was on steel lattice-work, scraping and wire-brushing the rust and "touching it up" with red lead. "Hedges" Green was my first experience of a foreman. He was never seen without his bowler hat and white apron—the usual foreman's uniform of that time. To the apprentices he was a tyrant, determined to make tradesmen out of us whether we liked it or not. I did not like it then, but now realise what a good teacher he was. He had one queer habit—he invariably put his aspirates in the wrong places. It was this peculiarity that gave birth to his nick-name and also drove home the little phrase. It sounded like this:—"Don't forget the hedges. Always put a little hextra on the hedges." Even with the tradesmen, when handing them their paint-pot and brushes and detailing the job to be done, he always ended with " . . . and don't forget the hedges."

In such a way life-long lessons are learned. This phrase is in every day use in my department and we always advocate when brushing or spraying to double-coat the "hedges." This is where rusting commences. Test panels usually have the edges rounded off, double-coated and sometimes waxed.

Paint-Key

The question of paint-key on non-ferrous metals has always been rather a problem. For the little man unable to afford "tank equipment", the advent of self-etching primers has provided an answer and it is cheap and efficient. Furthermore, during the present shortage of sheet metals, plastics or resin-bonded substances are being used as substitutes in many cases and the etch-primer has provided the all-important key-coat for a subsequent painting system.

In any type of paint finishing the foundation is of vital and paramount importance. The so-called one-coat finish can only be classed as a poor quality job. For example, wrinkle, crinkle or rivel finish, call it what you will, is, according to general advertising, possessed of magic qualities and will neutralise the inequalities of any surface. In other words it fills craters, file marks, etc., diminishes the protuberances and leaves a level surface. Similar claims

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have been made for "hammer" finish. The fact is, that the finishing coat is entirely dependent on the surface beneath it. If that surface is uneven your finish must be uneven also. With these "broken" finishes, including mottle, there may be an appearance of smoothness but this is only an optical illusion.

Wrinkle Finishes

With wrinkle finish it is possible to obtain varying effects, both in pattern and degree of gloss, according to the method of application and the metal treated. This may be observed after spraying and stoving an article built up from dissimilar metals which vary in surface-area to weight-ratio. The use of a suitable undercoat will help to produce a more even finish.

Whilst on the subject of wrinkle finishes, very few people seem to know the best method of application. One full wet coat is not the best method to use to achieve the best results. It is much better to build up by "dry spraying". Perhaps a hint on this may be useful to some readers. Adjust the gun to give a wide fan, irrespective of the width of the job: Use a high air pressure (60-70 lb.) and spray from a distance of 18-24 in. away. The object is to mist-coat several times and so build up to the required film thickness. For a heavier pattern formation, allow the first application to dry for 15-30 min., or longer if possible, and then build up again in the same way. It is advisable to allow plenty of "flash-off" time before stoving, and to extend the stoving time a little rather than increase the temperature in the case of the double-coated process. Some people like a fine wrinkle and some prefer it coarse. Alteration in viscosity and build-up will produce a variation of finish. The majority of wrinkle thinners "cut" quickly and a check on viscosity is advisable when the desired degree of finish has been obtained. I also suggest the use of a strainer, as little bits of skin can cause big blemishes in the finish. When stoving, bring the heat up slowly until the wrinkle has formed and then push up the temperature to the allotted figure—no further. Pastel shades of wrinkle have a tendency to brown, and it is much better to keep the temperature on the safe side and lengthen the stoving time.

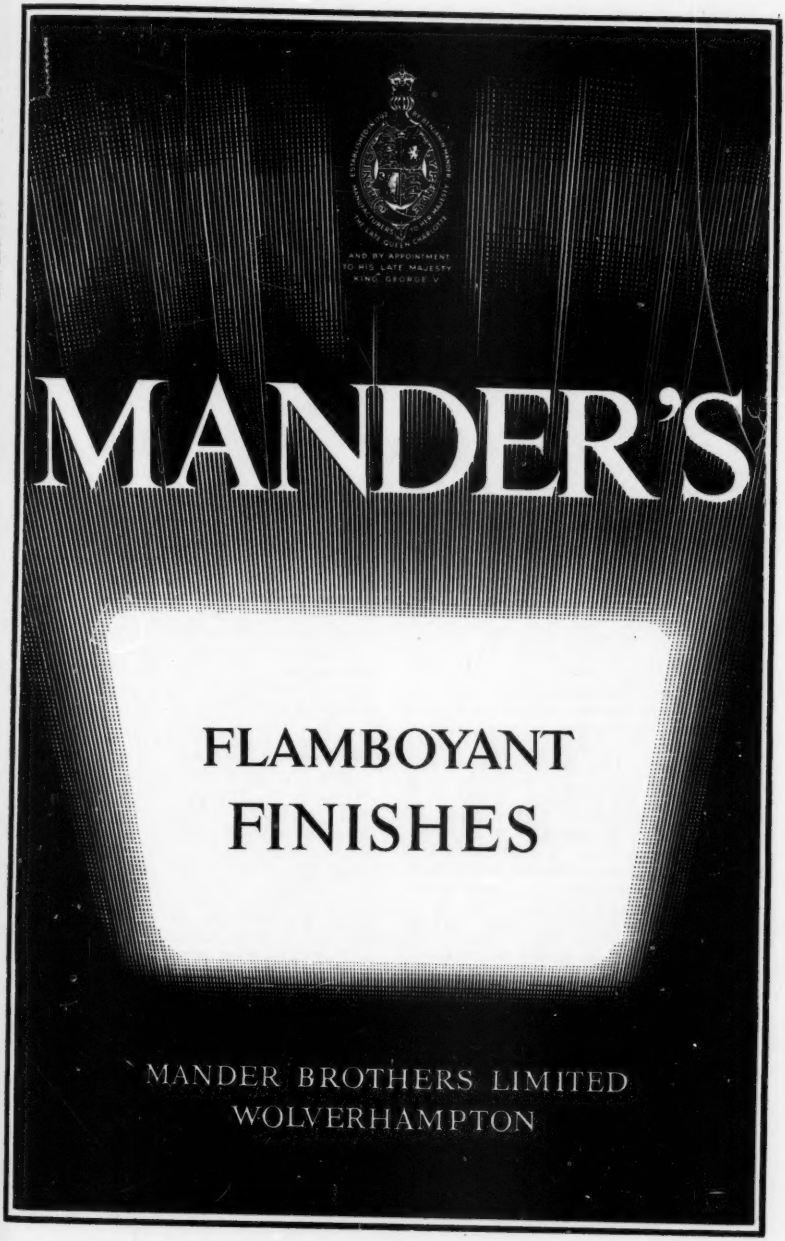
Wrinkle and hammer finishes are for spray application only; brushing and dipping are out of the question. Many enquiries are constantly being made regarding the possibilities of this. It is very peculiar how alternatives are always wanted. When the "half-hour" air-drying synthetic came into being, many people wanted to know if it could be stoved, dipped, speeded up, in fact anything at all except the job for which it was intended. Enquiries came in regarding the most unusual things. A man, up in Scotland, assured me that he had seen dipping polychromatics equal to, if not better than the sprayed version. Could we supply it? Unfortunately he couldn't remember the maker's name but everybody seemed to be using it. There have been people who have seen wrinkles air-dried in two hours. Another told me of a dipping "gold" that could be burnished after stoving at 250° F. for half-an-hour. These things are the "Indian Rope Trick" of the paint industry, now having replaced the once renowned barbers-pole paint gag.

At the same time, freak finishes are liable to arise simply by experimenting. Unfortunately they seldom have any commercial value. Crystalline, wrinkle, hammer, etc., all owe their origin to accident or experiment, being afterwards developed.

Methods of Application

The spectacular finishes of bygone days, such as marbling, shagreen, shading, crackle, and so on, which quickly followed the advent of the coloured low-bake synthetics, were in violent contrast to the sober monotonous black of thirty years ago. The present vogue of self-colour finishes in pastel shades is now having its run. The present trend of events seems to be centred on improved methods of application. Automatic spraying was followed by the electrostatic methods and now we have the hot-spray process. All these innovations, combined with modern systems of pre-treatment are improving industrial finishes to a high degree.

The paint trade, in common with all industry, is always on the search for something newer and better. Owing to shortages of raw materials or present high costs, production of a new development may be held up but the research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nevertheless goes on.

A technical service and development department is closely linked up with, and is a part of, this research. A paint formulation is arrived at after a series of tests and is designed for a specified purpose at a competitive price. The development section, knowing the theoretical limits of the product, then put the paint "through the hoop". In the case of a stoving finish, it is tested to "breakdown" on all the equipment available and under the best and worst conditions. The information gained from this may result in a modification of the formula or even to its being scrapped altogether. Whatever the results, the weaknesses have been discovered and the limits have been set. Consequently, when the paint manufacturer recommends an application and stoving schedule, also the use of a certain thinner, this is the best way to obtain the maximum results. The "trouble-shooter" investigating your complaint may probably be the one who has put this material through its paces and any short cuts or deviation from the recommended process can very easily be spotted.

It is during this period of putting paint through the hoop that anything in the way of a freak finish may be obtained. The questions then arising are: how does it affect the durability of the paint? Can it be produced at will? Is it fool-proof and has it any commercial possibilities?

AN OVERHEAD SPRAYING MACHINE

OUTPUT of finished skins in a Northampton tannery has been increased 500 per cent. by a new leather spraying machine. It comprises an endless chain conveyor with a continuous loop circuit, carrying the skins through successive spraying stations. The continuous circuit enables any number of coats of spraying medium to be applied, and, because of the plurality of coats permitted, quality can be improved.

An output of 1,440 skins an hour can be attained. This quantity varies with the size of skins and the finish being applied, but the output is said to be in any case substantially higher than with other spraying equipment.

The machine, the "Crosline" patented conveyor spraying machine, made by F. Lines, of Northampton, may consist of a single-loop circuit or one of four or six lines. Alternatively it may be an angular circuit.

At the spraying stations the skins are picked up from the chain conveyor by nylon conveyor bands. On these they travel through the spraying point in a flat, horizontal position, and during spraying they are held perfectly flat by air suction, which is a secondary function of the fume extraction system. The spray fumes are exhausted from below the conveyor bands, and the suction holds the skins tightly, without wrinkles, against the nylon bands.

The efficiency of the spraying stations is due to a large extent to the air circuit employed. The removal of fumes is effected through an extract duct connected to a well beneath the conveyor. Extraction at the rate of 1,750 c.f.m. is provided by a 15-in. single-stage Aerofoil fan, manufactured by Woods of Colchester Ltd. The straight-through axial air movement of the Aerofoil fan enables it to be connected directly to straight line ducting, and consequently the extract duct has been kept simple and compact. The fan has a power input of 0.49 b.h.p., running at 2,800 r.p.m., and its sound level is 80 decibels, about the same as the average background noise in a factory.

Since the angle of spraying is downwards, the extraction from beneath the work assists in controlling the direction of the spray and its flow to the skins. It also ensures that the upper part of the booth remains more or less clean. During operation the nylon conveyor bands are constantly washed in water, which avoids a shut-down for cleaning. Further means of water-washing the booth are provided to keep the interior clean and reduce the amount of airborne spray particles carried through the extract duct and fan.

The spraying can be done manually by operators seated at the open face of the booths, or by mechanically-operated guns. Auxiliary drying by heat or infra-red lamps can be arranged between the spraying stations. It is found, however, that with spraying stations 20 ft. apart, natural air drying is sufficient. The speed of the conveyor is infinitely variable, the most satisfactory speeds being from 900 ft. to 2,700 ft. an hour, according to the type of spraying medium used.

Finishing Armament Equipment

PART IV

Miscellaneous Treatments for Steel

DURING World War II, in the course of investigations upon tropical packaging, the corrosive influences of perspiration were noted. The British Standard packaging code, B.S. 1133/1943, recommended a methanol treatment which has since been further investigated.

Tests and Results

Steel specimens were ground finely, degreased with trichlorethylene, swabbed with a suspension of magnesium oxide in water, rinsed, dipped in acetone, and finally dried in an oven. The specimens were then marked by the natural perspiration from the fingers of one individual. The subsequent cleaning treatments were completed within half-an-hour whilst the specimens were then warmed first to 30° C. and kept for from 24-72 hours in air at a constant relative humidity of 90 per cent. at 30° C.

It was discovered that vapour degreasing in trichlorethylene or even direct immersion in the boiling solvent was ineffective and where finger marks were put on to the specimens in conjunction with oil, the corrosive effects were more marked than before degreasing which tended to show that the corrosive salts present although insoluble in trichlorethylene penetrated through the oil film and became adherent to the steel.

It appears that the fingerprint deposit consists of salt or salts of organic acids and whatever solvent might be used, there was something that they left quite undissolved. Methanol left some residue but it was not certain that all corrosive salt was completely removed although that remaining was in reality almost harmless.

As a result of tests, three methods appeared to be useful, but there does not seem to be any suggestion as to which is better than the other. Firstly, cold methanol immersion and subsequent oven drying; secondly, immersion in a cold solution of 0·1 per cent. sodium nitrite and 0·1 per cent. mild alkali such as borax, disodium phopshate or sodium metasilicate, followed by oven drying. In this respect the drying can be helped by passing the steel through a water-displacer in a second tank. As a water-displacer a mixture of white spirit and lanolin in the proportions 80 : 20 may be used, but in this case the use of silicates in the nitrite water should be avoided because it tends to cause emulsification. A later immersion in an emulsion of hot water and soluble oil with appropriate inhibitive properties is suggested. Further details are given in Report No. 9—*Methods of Removal of Corrosive Perspiration Deposits from Steel*—Ministry of Supply.

Bright Dip for Steel

The production of a bright surface on steel—including mild steel, medium carbon, plain and alloy steels, is obviously desirable and the method described in Report No. 10—*Bright Dip for Steel*—Ministry of Supply, gives a smooth surface but which although improving the appearance of pickled, corroded, or tarnished surfaces, does not give reflection of a clear image. The bright dip consists of immersion at room temperature or slightly above, in a solution of: Chromic acid CrO_3 500 gm/litre 5 lb./gal; sulphuric acid H_2SO_4 150 cc./litre 2 lb 2 oz./gal.

The reaction is exothermic which warms the solution, and to obtain

uniform results, gentle stirring by moving the articles or by blowing air through the solution is advisable. The bright dip has an appreciable degreasing action although the degree of cleaning prior to electroplating is not necessary. It is suggested that the article should be first immersed for a minute or two in 10-20 per cent. sulphuric acid, and then the articles are placed without rinsing in the bright dip solution for from a quarter- to half-an-hour. The articles are next rinsed thoroughly and dried off by hot water immersion or other methods. It is pointed out that the surface at this stage is highly reactive and if tarnish is to be prevented, they should be dipped in an alkaline solution followed by a rinse before drying.

The process is claimed to be successful on mild and medium carbon steel up to 0·5 per cent. and on low carbon alloy steels, whilst high carbon steels when in the hardened state are brightened, although the action does not take place when they are soft. In the case of cast iron, the surface is etched but not brightened. There is some metal loss: approximately 0·2 gm. per sq. in. per hour at 18° C., equivalent to a thickness loss of 0·0015 in. per hour.

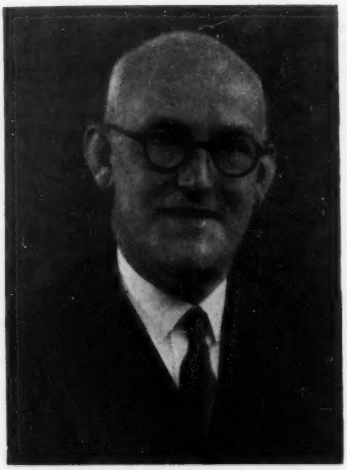
Where it is necessary to electroplate on to the surface, it is important that there should be a thorough rinsing to avoid contaminating the plating bath, after which immersion in hydrochloric or sulphuric acid is necessary to dissolve any acid film produced in the brightening treatment—then the parts are plated.

Lanolin Solutions

In Report No. 11—*Protection of Steel by Different Lanolin Solutions*—Ministry of Supply tests are described in which lanolin was dissolved in different solvents. After the films had been applied to steel plates, they were exposed outside, inclined in porcelain cleats, at 10° to the horizontal on a flat roof facing towards the West, at Swansea. The atmosphere there could be described as partially industrial, marine and rural, whilst throughout the tests the weather was in the main, mild and wet. The panels were exposed for periods between fifty or sixty days, the period required to show the commencement of rusting, and then up to 125 to 150 days for complete rusting.

It was concluded that with the exception of very thin films, the degree of protection of steel offered is directly proportional to the thickness of the film. When the films are applied by dipping solutions in the solvent naphtha, they give only slightly thicker films than from solutions in white spirit, whilst solutions in volatile benzine give substantially thicker films than solvent naphtha solutions.

When dipping is carried out at 40° C. there is little difference in so far as film thickness compared with ordinary temperatures, except when the weakest solutions were dipped at 0° C. Lanolin-white spirit, 35:65, gives a similar film thickness in dipping to 30:70 lanolin-naphtha, so that either solution would give a similar degree of protection.



Mr. G. A. Shaw has been recently appointed as the Midland area representative for the Building and Decorating Division of Cellon Ltd., Kingston-on-Thames. Mr. Shaw joined the company's Midland branch in 1933, being in charge of the Order Department, so that for many years he has been round and about in the Birmingham district, and is extremely well known. The Midland office of Cellon Ltd., where Mr. Shaw can be contacted, is St. Paul's Square, Birmingham 3. Telephone No. Central 5234

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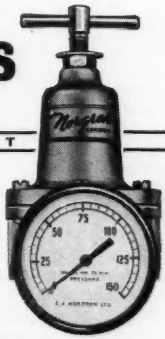

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M-W.107

View of the new Micafine Ltd., Derby factory which cost £250,000. It is the only works in this country supplying mica powder for paints and industrial finishes both at home and to the Dominions, Colonies and Europe.

MICA FOR SURFACE COATING

MICA has a laminar structure and when ground to form a constituent of paint and other film-forming compositions, the process is essentially one of delamination. The layers of the original flakes are separated into thinner flakes, and though the surface areas of the flakes are also reduced simultaneously, the characteristic laminar form of the natural mica is maintained even in the finely-ground product.

The Mica Barrier

Since the primary object of film-forming compositions is to protect the surfaces on which they are applied against the corrosive effect of external influences, the inclusion of a chemically inert agent like mica with laminar properties might be expected to provide added protection. In fact, no practical film is completely impervious to water or water vapour, but the interposition of a virtually impenetrable barrier like that which is provided by mica obviously enhances the impermeability to water in both forms. For example, one can delay the rusting which occurs from the action of water and oxygen provided by the atmosphere. In the case of a paint film, the oxygen of the air may reach the metal surface underneath by means of a definite fissure in the protective film, by a normal gaseous diffusion process, or in dissolved form as a water solution, but the barrier which is provided by mica particles is capable of restricting the supply of oxygen to a metal surface. Penetration by ionisable salt solutions capable of stimulating corrosion may be retarded by a mica barrier. Likewise, the action of the alkalies frequently encountered in new plaster, cement, or concrete, can be impeded by a suitably constructed primer based on mica. In fact the mica barrier may be exploited in all types of coating where chemical resistance is required.

Apart from protection, mica is an anti-settling agent. The frictional resistance afforded by the very large surface area of the mica particles, when dispersed in oleo-resinous and synthetic resin media, stops ready settling, and the slowly settling mica

particles prevent the naturally rapid deposition of some very heavy pigment particles. The rate of settling of heavy pigments is reduced, and the condition of the ultimate mixed settlement is such that it is easily redispersed by simple stirring.

In all products where the presence of a pigment or filler is necesary to confer some special property on the applied film, good dispersion of the pigment or filler is essential. Mica powder is no exception in this respect. Research has been conducted with the main object of providing the best dispersion possible, and the effect of many dispersing agents on mica powder has been studied. Of those examined, zinc and calcium naphthenates were found to be the most effective, with the zinc soap preferred to the calcium.

Test Conditions and Results

A series of conventional oil base primer paints were prepared, using such anti-corrosive pigments as red lead, zinc dust, zinc chromate and red iron oxide. A second series of paints contained these same pigments with the addition of 11 per cent. by weight of mica based on the main pigment. Because of the low packing density of mica powder, the volume of mica present by comparison with the volume of the main pigment was substantially greater than 11 per cent.

These paints were applied to two sets of clean steel panels which were then subjected either to continuous exposure at 42-48° C. and 100 per cent. humidity, or to an intermittent salt spray, operating 9 hours on and 15 hours off for each 24-hour period.

With the red lead paints, under both forms of corrosive conditions, namely 4 months at 42-48° C. and 100 per cent. humidity, or 17 days' salt spray, it was found that the above proportions of mica could be tolerated without really noticeable diminution of anti-corrosive properties. This indicates that mica can be introduced to reduce the cost of this eminently successful but rather expensive type of primer.

With the zinc dust paints the presence of the mica was found to be a definite advantage in preventing corrosion at 42-48° C. and 100 per cent. humidity after 4 weeks' exposure. Under salt spray conditions (4 weeks) the presence of the mica was found to be no advantage, but at the same time was no detriment. In such paints, therefore, mica can be used either to enhance the anti-corrosive properties and/or to reduce costs, depending upon the nature of the corrosive conditions.

In straight iron oxide anti-corrosive paints the presence of the mica reduced the corrosive effects of both types of corrosive conditions.

In iron oxide, zinc chromate paints, exposed to salt spray conditions (15 days), the presence of mica was an advantage. At 42-48° C. and 100 per cent. humidity the effectiveness of the mica varied with the type of mica.

The use of mica with aluminium pigment was also investigated with particular reference to its effect on anti-corrosive properties. A special low acid value metallic paint medium with pronounced floating properties was prepared, and pigmented with a fine aluminium paste. The amount of paste used was limited to 7·0 per cent. by weight of the metallic paint in the case of the control. In a second paint this quantity of aluminium paste was reinforced with 8·5 per cent. of powdered mica. Steel panels coated with the two types of paint were exposed to salt spray conditions and also to 100 per cent. humidity at 42-48° C. The paint containing the mica, in addition to the aluminium pigment, was found to resist these corrosive conditions better than the paint containing no mica.

Sealers

The problem of producing a satisfactory primer or sealer for application to new plaster, cement or concrete, is an ever present one. Such sealers are employed to check the movement of alkaline solutions from the plaster, etc., into the paint coating applied over it, where it may cause saponification and, in bad cases, complete liquefaction of the coating. A good sealer is based on a suitable combination of alkali-resisting medium and a mineral filler, in addition to pigments introduced mainly for colouring or tinting purposes. The effect of the mineral filler can be very marked indeed.

To test the efficiency of mica powder as a mineral filler in these products, it was ground into a wood oil-phenolic resin medium, and its sealing properties compared with those of the unpigmented medium by applying both to the upper surface of cement blocks only three days old. Because of the great absorption of the sealers by the cement, it was deemed advisable to apply a second coat, and this was followed ultimately by the application of a conventional type of chrome green hard gloss paint. After allowing the hard gloss paint to dry for two days, the blocks were immersed to within ½ in. of the painted surface, the unpainted surface of the blocks being submerged.

The efficiency of the sealers was judged by noting the extent of the area of the chrome green surface from which the prussian blue was bleached out at the end of a given period of immersion. Under these conditions of test, which are much more severe than those normally encountered in practice, the presence of the mica was shown to be an advantage in retarding attack by alkali.

Metallic Pigments

Metallic pigments, aluminium and bronze, resemble powdered mica, in that they possess the characteristic flake shape. It is not surprising, therefore, that mica has been suggested as an additive to metallic paints.

Good metallic pigments have a much more pronounced floating tendency in suitable media than mica powders, but mica powders can nevertheless be added judiciously to metallic paints with advantage. The beneficial effect of mica in aluminium primers subjected to corrosive conditions has already been described.

It has also been found experimentally, that very substantial amounts of mica can be incorporated in aluminium paints without reducing opacity to an unsatisfactory level. For example, in a paint containing only 0·66 lb. aluminium paste to 10 lb. of medium, 1·33 lb. of mica powder can be introduced to yield a paint with adequate opacity. The presence of the mica is also useful in increasing the "body" of the paint without increasing the viscosity of the medium which it is desirable to keep low.

In the past it has sometimes been suggested that the mica powder be mixed into the metallic paint at the same time as the aluminium pigment. Because, however, of a flocculating tendency of the mica particles it is preferable to grind the mica in part of the medium, possibly with a dispersing agent, and blend this dispersed paste into the remainder of the medium.

In bronze paints where a heavier pigment is used, mica has useful functions in reducing the rate of short-term settling of the bronze pigment, such as is likely to occur in the storage tank during application by spraying, and it also facilitates the stirring necessary to redisperse settled pigment.

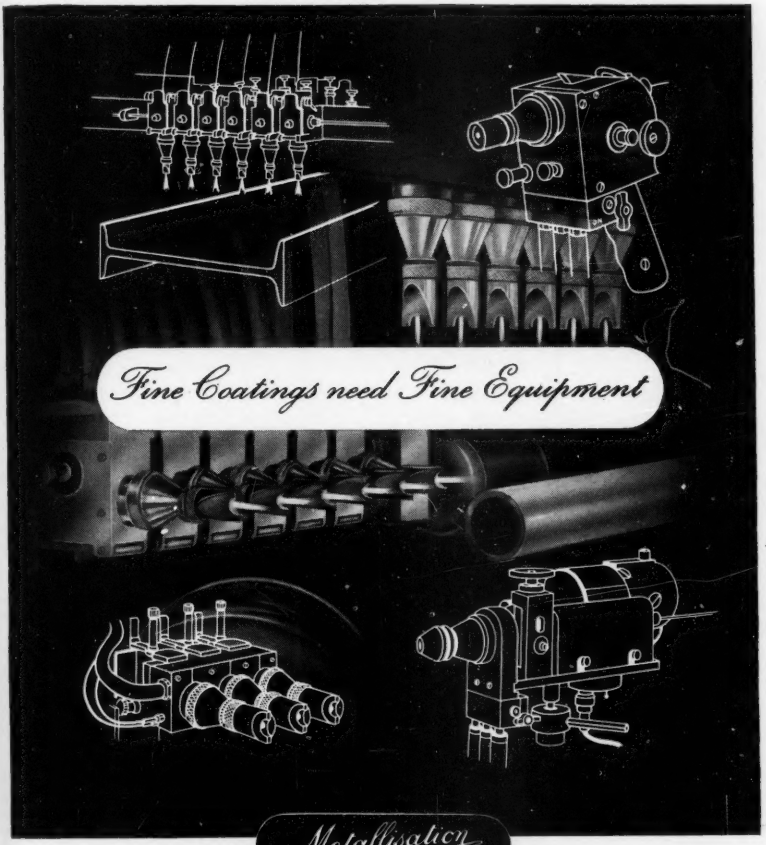
Experiments Undertaken

Certain pigments are prone to settle, and the tendency to settle varies according to the composition and physical properties of the medium in which the pigments are suspended. In order to obtain a true general picture of the efficiency of mica as an anti-settling agent, experiments were conducted both with a variety of pigments and media.

The pigments and filler selected for these tests included red lead, white lead, reduced titanium dioxide (25 per cent.), lithopone, and barytes. The media included boiled linseed oil—varnish linseed oil—linseed stand oil mixture, linseed-congo copal varnish, wood oil—pure phenolic resin varnish, 60 per cent. linseed alkyd varnish, linseed stand oil—rosin maleic adduct medium, linseed stand oil—limed rosin medium, linseed stand oil—modified phenolic resin medium.

The method of conducting the test was to grind the pigment or filler with mica in the various media, and to adjust them to a viscosity of about 30 sec. Ford Cup No. 4 at 25° C. by addition of white spirit. The lower than normal viscosity was deliberately chosen in order to accentuate the settling tendency and to allow settling to occur under a gravitational influence only. Glass tubes 1 in. dia. were filled to a height of 4 in. with the paints and were judged for settling tendencies by observing the height of the settled pigment column at definite intervals of time. After more prolonged ageing, for periods up to one

METAL SPRAYING BY THE WIRE PROCESS GIVES THE GREATEST PROTECTION AGAINST CORROSION



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month, the settled pigment plug was examined for general characteristics, including compactness and resistance to re-dispersibility. Different types of mica were included in the experiments, and each series contained a control involving pigment or filler only, with no mica.

The following are the tabulated results obtained, in general terms, and it should be noted that in all cases the pigment-mica mixtures were prepared by simple grinding without the assistance of any special wetting or dispersing agent.

It is now believed as the result of other experimental work that the use of a wetting agent might reveal enhanced anti-settling properties for the mica.

Type of medium	*Pigment or Filler present*	*Effect of mica on settling rate*	*Effect of mica on redispersibility of settled pigment plug*
Boiled linseed oil—varnish linseed oil—linseed stand oil mixture	White lead	Increased the settling rate	Easier
,, ,,	Barytes	None	Slightly easier
Boiled linseed oil—varnish linseed oil—linseed stand oil mixture	Red lead	Noticeable retardation	Slightly easier
,, ,,	Titanium dioxide (25 per cent.)	Increased settling rate	No effect
Linseed stand oil—rosin maleic adduct medium 2½:1	White lead	Increased the settling rate	Easier
,, ,,	Barytes	Appreciable retardation	Much easier
,, ,,	Red lead	Increased settling rate	Easier
,, ,,	Titanium dioxide (25 per cent.)	No material effect	Much easier
,, ,,	Lithopone	Increased settling rate	Easier
Wood oil—pure phenolic resin medium	White lead	Increased settling rate	Very much easier
,, ,,	Barytes	Appreciable retardation	Easier
,, ,,	Red lead	Increased settling rate	Easier
,, ,,	Titanium dioxide (25 per cent.)	Increased settling rate	Easier
,, ,,	Lithopone	Increased settling rate	Much easier
Linseed alkyd medium 60 per cent. oil length	White lead	Increased settling rate	No effect
,, ,,	Barytes	Noticeable retardation	Much easier
,, ,,	Red lead	Appreciable retardation	Much easier
,, ,,	Titanium dioxide (25 per cent.)	No effect	No effect
,, ,,	Lithopone	Increased settling rate	No effect
Linseed oil copal medium	White lead	Increased settling rate	No effect
,, ,,	Barytes	Noticeable retardation	Much easier
,, ,,	Red lead	Appreciable retardation	Much easier

Type of medium	*Pigment or Filler present*	*Effect of mica on settling rate*	*Effect of mica on redispersibility of settled pigment plug*
Linseed oil copal medium	Titanium dioxide (25 per cent.)	Increased settling rate	Much easier
„ „	Lithopone	Increased settling rate	No effect
Linseed stand oil limed rosin medium 2:1	White lead	No effect	No effect
„ „	Barytes	Noticeable retardation	Very much easier
Linseed stand oil limed rosin medium 2:1	Red lead	Noticeable retardation	No effect
„ „	Titanium dioxide (25 per cent.)	No effect	No effect
„ „	Lithopone	Increased settling rate	Easier
Linseed stand oil-modified phenolic resin medium 2:1	White lead	No effect	Slightly easier
„ „	Barytes	Noticeable retardation	Very much easier
„ „	Red lead	Appreciable retardation	Much easier
„ „	Titanium dioxide (25 per cent.)	No effect	No effect
„ „	Lithopone	No effect	No effect

It is apparent from the foregoing results that each case of settling must be treated on its merits, and if mica is introduced with discretion there are a number of types of product where its presence can be very beneficial, and a larger number where it facilitates ease of redispersion of settled pigment.

For the information provided in this article acknowledgment is made to Micafine Ltd., Raynesway, Derby (Derby 55981—2 lines).

FATTY ACIDS

UNDER the above title, a useful handbook has been issued by Hess Products Ltd., 4 Albion Street, Leeds 1, covering the range of fatty acids produced in their Littleborough, Lancashire, fractionating plant. The company point out that they are always prepared to make new products to satisfy particular demands, and to offer new fatty acids to the research and development departments of those firms likely to be interested. They point out that in the paint and printing ink industries, sales are being handled by Leon Frenkel Ltd., 28a Basinghall Street, London, E.C.2.

The handbook describes the "Distec" range of saturated, unsaturated, and mixed fatty acids, whilst each product is specified in terms of acid value, saponification value, etc., giving the average composition and uses to which the material is put by a variety of industries.

"Canning" Quarterly News.—July, 1952 was the first printed issue of this house organ of W. Canning and Co. Ltd., Birmingham. It deals primarily with the sports activities of the various branches of the company, but the editor writes to say that it is hoped that in future he will be able to extend the scope of the journal and include a variety of different subjects of interest to members of the company.

L. Kekwick.—Mr. Leslie Kekwick, president of the Oil and Colour Chemists' Association, is undertaking an overseas business trip in the autumn, and as he will be visiting South Africa, Australia, and New Zealand he will be able personally to contact the O.C.C.A. sections in the British Commonwealth countries. Finally, he will visit the United States and hopes to attend the annual convention of the Federation of Paint and Varnish Production Clubs. He leaves London on 9th September.

(Continued from "Industrial Finishing," August, 1952)

Production Efficiency in Metal Finishing

By

H. SILMAN, B.Sc., F.R.I.C., F.I.M., A.M.I.Chem.E.

(President, Institute of Metal Finishing)

THE introduction of automatic plant for polishing and plating is nowadays considered essential for large-scale production. For maximum efficiency an automatic plant should be designed to carry out the complete cycle of operations to produce an article ready for assembly. For example, when a component comes from an automatic plating plant, it should not have to go through another plant to dry it. The cost of the extra handling involved can multiply the advantages of the automatic machine to a wholly disproportionate extent. Automatic barrel plating plants are bad offenders in this respect as usually the plated articles have to be dried in a centrifugal unit after plating. To produce a fully-dry article from a barrel plating plant is a formidable but not insuperable problem.

Similar considerations apply to cleaning; a full cleaning cycle should be provided to enable the plant to deal with the most highly contaminated articles that may come along, without additional external cleaning operations. It is better to provide for such contingencies by incorporating an extra tank or even two in the plant when it is first built, rather than to attempt to do so later when it may be impracticable.

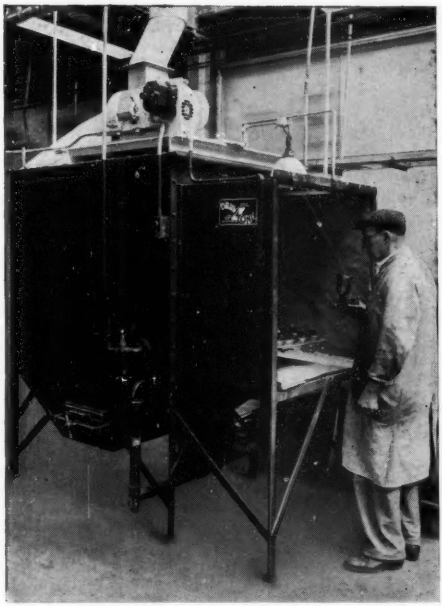
Plant Flexibility

This brings us to the question of flexibility. One of the features of the finishing industry today is the rapidity with which new methods and processes are being developed. Yet automatic plants are constantly being built to take care, in this country at any rate, of production requirements for ten or fifteen years ahead. It is, therefore, a somewhat hazardous matter to build a costly plant to carry out a closely-specified cycle of operations which is not easily variable. Where this has been done, in some cases (usually on grounds of economy) the plants have become out-of-date rapidly as it has not been possible to take advantage of new developments with them. In the case of a plating plant there is no guarantee that the process for which it was designed to operate will not be superseded long before the budgeted life of the plant is reached, in which case it may have to be scrapped if full efficiency is to be maintained. In the U.S.A. plants are built for a much more limited life than is usual here, so that the problem is a less serious one; here, with less capital available for new equipment, scrapping of obsolete plant tends to be delayed, so that it is especially desirable for machines to be designed so that modifications to the process originally specified can be carried out. It may be necessary to do this not only because of technical improvements but also to meet production requirements which may arise due to changes in design or materials of construction. To do this may mean the provision of additional tanks which may not seem to be immediately necessary, adequate bus-bar installations and electrical equipment to allow for possible increases in current densities, chemically resistant tank linings to take care of possible changes in solutions, and the use of pipe lines, filters, pumps, etc., of a type that can be employed with a wide variety of solutions. All these and similar modifications cost money, but such expenditure should be regarded as a form of insurance.

On the question of the optimum size for an automatic plating plant,

(Address delivered to a joint meeting of the Institute of Metal Finishing and the Institution of Production Engineers at the Engineers and Shipbuilders' Institute, Glasgow on June 18th, 1952.)

WATER WASH SPRAY BOOTHS *of* GREATER SIMPLICITY *and* HIGHER EFFICIENCY



There are no pumps, nozzles or filters to choke or need attention. The only moving part is the fan, which handles the clean dry air from the high efficiency wash and discharges it to the atmosphere.

We can supply the washing plant in separate units for building into your own booths, to give the above advantages. We can also offer the same advantages of clean exhaust with very little maintenance for DUSTS AND FUMES FROM POLISHING, GRINDING AND PLATING

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this depends on the type of work being plated, and on the factory layout; in general, however, smaller sizes than have been built in the past are to be favoured. Indeed, for many plants (especially where jobbing work is done) there is considerable scope for a really small compact and simple automatic plant of a type which does not yet appear to be available, although there is equipment on the market which is beginning to approach this need.

Time

It is a truism to say that the most expensive constituent of any manufactured article is time. In its more obvious aspects time is calculated and costed very closely, especially by those organisations which are engaged in mass production. Operations are timed with great accuracy and paid for accordingly, but many time losses which occur in industry and add to costs are not as well controlled, and are, indeed, not easily assessed. Leaving aside the tea breaks which are sacrosanct in this country, but which the Americans seem to be able to do without, some of the most costly delays are due to the growing length of time taken in the making of decisions. To a certain extent the system of committees has not helped, but such time losses have increased throughout the range of industrial activity. Long deliveries in plant are often due as much to internal delays in the placing of orders and the fixing of specifications than in the actual time taken in manufacturing operations. The responsibility for this situation must be laid squarely on the shoulders of executives in industry and in the Government.

Once a decision is reached to install a plant which will effect certain savings, every day of delay represents a time loss which is an item of cost to the organisation concerned, and to the nation as a whole. One of the major objections to over-Government is that the delays which are inevitable in the operation of all official systems of control are excessively costly and that this cost, although to all intents and purposes incalculable, must be very high indeed.

Another factor which is regarded as inevitable when production and control systems are organised, is the vast amount of paper work which occurs. Apart from the question of form-filling, which need not be emphasised here, there is the fact that the written word is a strictly limited medium for the conveyance of technical information. To be effective it must be supplemented firstly by verbal exchange, and next by demonstration. For this reason where the exchange of technical information is concerned and the need is urgent, the principle of never writing when one can telephone, and never telephoning when one can go, might be adopted.

The danger of being submerged in a mass of paper-work which is not conducive to constructive thinking is a real one. All papers have to be filed, sorted, recorded and carried, which further adds to the overheads of an organisation, and very often a system is installed to ensure that some contingency, which is unlikely anyway, should never arise. It might be argued that the cost of over-organisation, like the cost of over-inspection, is more than the risks involved warrant; of course, much of the paper-work in use in industry is essential, but a manufacturer who is considering the installation of a system which will involve an increase in clerical labour should carefully offset its own cost against the estimated savings. Even in the United States, where the mechanisation of accounting and clerical work has gone much further than in this country, it is worth while recording that over the last twenty-five years production has increased nearly two-fold with an increased labour force of 50 per cent., whilst clerical staffs have increased 150 per cent. The situation is probably worse here where such extraneous functions as canteens, social organisations and tax collection are carried by industry to an extent which is unknown in the U.S.A.

The Human Factor

The rôle of efficient management in productivity cannot be exaggerated, yet we are only beginning to pay adequate attention to the economic aspects of personnel considerations in management.

Labour relations are now well understood, and welfare, consultative committees, wages boards, and so on,

are an essential part of the organisation of industry today. Executive and management staffs are, however, less well catered for. Management and technical staffs represent a very substantial investment on the part of the organisation which has trained them, and the wastage in producing men and women of adequate capabilities for dealing with the problems of present day industry is high. Much of their training consists in making mistakes and learning from them at high costs to their employers. It is, therefore, more desirable than ever that these valuable assets towards high productivity should receive adequate consideration. More is needed than adequate remuneration; top executors working at high pressure are peculiarly susceptible to some diseases which may incapacitate them for long periods. It must also be remembered that the hours during which an executive's mind is engaged on his work cannot be controlled by his employers and often not even by himself, in either an upward or downward direction. Equally, the quality and speed of his decisions are not controllable. Adequate appreciation of these human limitations can do much to improve the efficiency of managerial staffs.

Obvious Points

The elimination of unnecessary strain by the provision of working accommodation having reasonable standard of quietness, lighting and ventilation are obvious points which are ignored in a surprising number of cases. Noise level reduction in offices is common in the U.S.A., but hardly recognised here as an important need. It is also desirable that those concerned should have time to think and not be submerged in undue detail work. Facilities for wide personal contacts with others in their industry are important if men are to be fully useful to their organisations. Regular medical examinations to detect health troubles due to stress and strain before they become obvious should be more widely introduced. The victim of overwork is often the last to recognise the need, or indeed the practicability, of a respite before it is too late. Human equipment in industry at all levels should today be treated with no less care than other valuable machinery; with the vastly increased technical training required to produce executives we simply cannot afford to treat them casually. This is not even humanitarianism; it is a sheer economic necessity.

It seems curious to suggest that there are any hazards attached to improving productivity, but if this is done by mechanisation involving large capital investments, there are risks involved which must be clearly foreseen. First and foremost it must be remembered that a highly-mechanised plant becomes exceedingly inefficient when it is working at less than full output. Economies in operating costs cannot easily be effected. Reduction in the wages bill are of limited value since plant maintenance, capital charges, and depreciation go on inexorably and reflect themselves in high overheads spread over a lower output. Moreover, obsolescence continues whether the plant is producing or not. If the reduction in output is due to inability to sell the product, the situation is worsened since prices rise due to increased overheads per unit. In such a case research may help by lowering costs or improving the saleability of the articles concerned. If the limited output is due to shortage of raw materials, price considerations are of less importance, as the supply is often less than the demand which makes the recovery of excess costs easier to achieve.

It is thus seen that efficient high productivity is dependent on a constant supply of raw materials and an assured market. In the absence of these the modern highly-mechanised manufacturing unit can be a millstone around the neck of its owners.

Sir William Thomas Griffiths.—Sir William Thomas Griffiths, D.Sc., F.R.I.C., F.Inst.P., F.I.M., formerly chairman and managing director of the Mond Nickel Co., died in hospital at Redhill, Surrey, on 30th July at the age of 57. He was a past-president of the Institute of Metals and had served on the councils of the British Non-Ferrous Metals Research Association, the British Cast Iron Research Association, the Federation of British Industries, and the advisory council of the department of Scientific and Industrial Research.

New Developments

A RECENT discussion by several U.S. manufacturers of ceramic-coated materials with metallic base, resulted in a number of suggestions in regard to conserving cleaning materials, conserving sulphuric acid and nickel salts, and conserving sodium-cyanide.

Of these, a plant-designed oil separator tank used in conjunction with the cleaner tank considerably extends the life of cleaning solution. Often these solutions fail to function properly simply because oil scum that has accumulated at the top of the cleaning tank is redeposited on the metal during cleaning. In one plant, a modification of this arrangement is prolonging the life of cleaner tank solutions five times or more when a separate device is used for sludge remover.

Suggestions for saving sulphuric acid are:—

(a) When purchasing sulphuric acid, inspect the storage tank, all transfer pipes, and all valves and fittings in order to prevent loss of acid because of failure of these parts;

(b) When measuring acid for addition to the pickling tanks, use a vessel of earthenware or iron to catch dripping acid that might otherwise go to waste;

(c) Nickel salts can be conserved by keeping storage tanks as dry as possible, placing them on pallets off the floor. Several suggestions are also given for preventing waste of nickel salts rendered unfit for use because of the presence of iron sludge in the bath;

(d) Conserving sodium cyanide. At one plant, the use of a relatively small amount of caustic soda has reduced the amount of sodium cyanide required for neutralising solutions by approximately 50 per cent.

(Better Enamelling—November, 1951.)

Electroforming

Electroforming, a process of electroplating on to the surfaces of moulds or mandrels, has been found to be equally adaptable to either experimental work or large-scale production.

The process leaves a shell of electrodeposited metal which reproduces original contours as closely as ∓0·00.5 in. The metal cross-section built up is of high density and has a high-speed deposition rate of 0·010 in. per hour. The ideal material is nickel, but copper, silver, iron, and other metals have been successfully used.

A typical plant using this process employs a 38 ft. long oval tank that requires only one operation to sustain 500 mandrels in a plating bath. As many as 500 pieces an hour can be turned out. The process solves such problems as producing metal parts having corners and extremely sharp points, intricate contours and close tolerances.

It can eliminate the expensive and time-consuming processes of machining away large quantities of excess material and complicated drawing operations. In its own field, it can compete with machining, forming, and other metal-working operations in common usage.

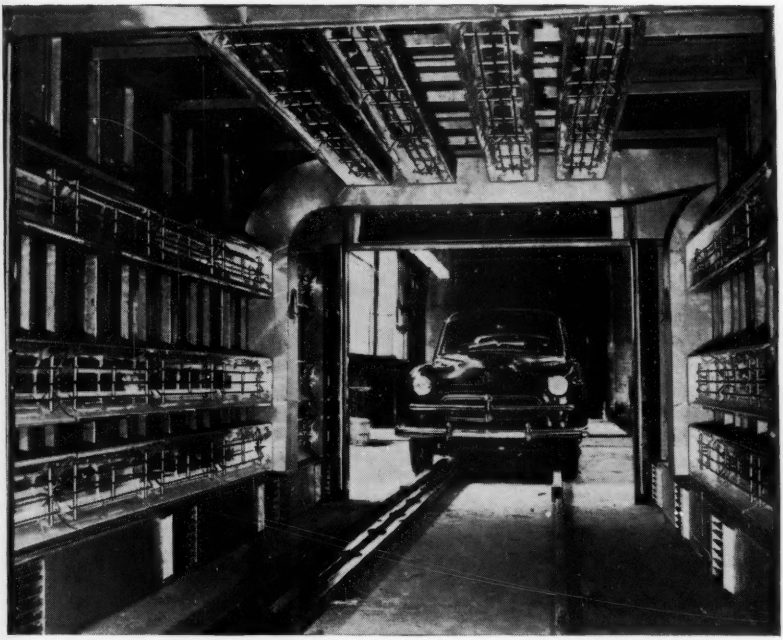
(The Iron Age—December 6, 1951)

Mass-production Finishing of Small Parts

A novel finishing set-up that washes, phosphatises, rinses, dries, paints, and bakes regulator covers for generators at a rate of 1,440 units per hour, has been installed in one of the Ford Motor Co. plants at Ypsilanti, Michigan. All six of these operations are performed in a single automatic system composed of several components that have been assembled into one integrated unit. It is extremely compact—about 10 ft. high and occupying only 21 ft. × 14 ft. of floor space—and can be easily moved to various locations in the plant if desired.

The covers, 5 in. long, 3 in. wide, and 1¾ in. deep, are carried on a monorail conveyor at approximately 4 ft. per minute. In operation, the parts are loaded six to a rack, on to fixtures that hang from a conveyor. The first section of the system is 18 ft. long and is divided as follows:—3 ft. for approach, 6 ft. for washing and phosphatising, 4 ft. for draining, 2 ft. for rinsing, and the last 3 ft. for further draining. Cleaning and phosphatising are accomplished in one operation.

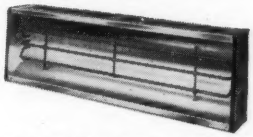
Metrovick Infra-Red speeds the cars . . .



A Vauxhall car in front of one of the four Metrovick Infra-Red drying ovens.

VAUXHALL MOTORS LTD have recently installed at their Luton factory four Metrovick Infra-Red ovens, arranged as two pairs. The first oven dries moisture off the car after water spraying and takes only FOUR MINUTES; the second oven dries any spotting of cellulose paint necessary before the finished car leaves the factory. The drying time in this oven is about THREE MINUTES.

The basic element projector, shown opposite, is made in standard sizes, 18 in. 24 in. and 36 in. long, and special lengths can be supplied. The source of radiant heat is the Metrovick tubular-sheathed heating element, an industrial adaptation of the successful "Redring" domestic element



Our Heating Element Department will be glad to discuss your heating problems, and the demonstration rooms at Trafford Park, Manchester and 132/135 Long Acre, London are open for inspection and the actual testing of samples.
Descriptive leaflet 703/7-1 will be gladly sent to you on request.

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From this section the conveyor makes a 180° turn to bring the parts through the drying oven. The parts then make another 180° turn and travel through a paint-dip tank.

This is mounted on top of the paint storage tanks and special fire preventative systems have been installed. From the dip-tank the parts enter the baking oven and, from there, the conveyor descends to the normal elevation of 6 ft. and enters the loading and unloading area.

Although designed for a specific purpose, similar equipment would be applicable to any finishing process where small parts are to be finished in large quantities.

(Products Finishing—September, 1951)

Special Finishing Technique for Space Heaters

Working closely with its paint supplier, and using plant facilities advantageously, an American company has developed an efficient set-up for finishing its range of space heaters. The firm's finishing technique, together with the use of special heat-resistant coatings, has made it possible to improve cabinet design so that many parts, such as shields or baffles, generally used on other heaters, have been eliminated, with a resultant saving of metal.

A mobile welding jig is used for holding the cabinet parts. A quick clamping device holds the work, which moves round a circular floor track from one welding station to another. Most of the welds are such that each worker uses only one type of welding tip. Welded cabinets are carefully inspected for defects, and all surfaces and weld roughness are smoothed with a portable disc sander. Dents are pounded out with hammers and blocks. Hand trucks move the cabinets to the finishing room where they are hung on an overhead chain conveyor on which they remain until completely painted and ready for final assembly. The entire conveyor line from cleaning to assembly travels at a steady rate of 5 ft. per min.

The cabinets are cleaned with both vapour and slushing equipment which completes the operation in an 8 min. cycle from entrance to exit of the degreasing tunnel, the conveyor doubling back upon itself. After leaving the degreasing tunnel, the parts travel about 30 ft. to 12 ft. water-wash spray booths, and are then carried through the drying area.

In the spray booths, the interiors of small heaters receive a light coating of paint. The outsides are given a heavy coating of a specially developed enamel that is very durable, heat-resistant, and protective. To reduce the effects of high temperature in operation, on the surfaces, the interiors of larger heaters in the range are coated with a specially developed aluminium bronze paint. A uniform viscosity of paint is maintained through all finishing operations. Paint storage tanks supplying the spray guns are positioned in a special water bath with a steady temperature of 78° F. The cabinets and their parts are kept together in job lots so that in final assembly a cabinet painted today will not be fitted with a door or shutter painted a week before. This precaution prevents the possibility of colour variation developing in the various sections after a period of use. An interesting point is that an automatic air-powered lubricating device is incorporated in the conveyor chain to overcome the extreme drying conditions which would otherwise occur due to repeated trips of the conveyor during the washing, drying, and packing stages of the finishing operation.

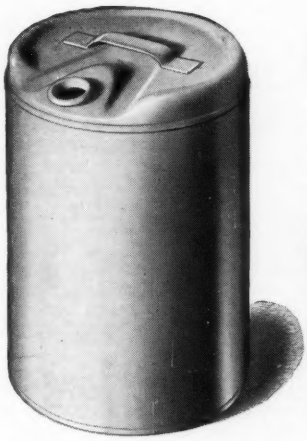
(Industrial Finishing (U.S.)—November, 1951)

Differential Electrolytic Tinning

The possibility of differential metal plating, where a different weight coating is applied to each side of metal containers, as a tin conservation measure, was demonstrated during the last war. Now, experimenting along the same lines with tin plating, the Weirton Steel Co., Weirton, Virginia, has successfully developed five combinations of differential coated electrolytic tin plate. The savings in tin, resulting from the adoption of a differential for the grade previously used, are said to range from 16·7 per cent. to 50 per cent., the amount saved varying with the weight combination used.

The process employed is the acid type similar to that commonly used in Europe. Plating is done by the Halogon process and the electrolytic production-plating lines are constructed horizontally to permit the deposition of tin on one side of the strip at a time. The

The patent top



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plating section has two tiers of twelve electrolyte cells each, or twenty-four cells in all. Each cell can be operated independently, as can each of the two plating tiers.

Most of the differential coated electrolytic tin plate distributed by this Company to date has been of the 50/100 grade for plant-packing tomato juice and other tomato products.

Additional applications include closures, home canning lids, and meat and soup containers. Satisfactory performance was reported in each case.
(Steel—December 17, 1951)

New Iron Plating Method

A plating bath for electrodeposition of iron, which is claimed to have a number of advantages, has recently been developed by the Van der Horst Corpn. of America, Olean, New York. The process produces an iron known as Vanderloy M. It produces a fine columnar structure with the grain perpendicular to the surface of the material to be plated, and is reported to bind so perfectly that the plating is virtually indestructible.

The bath is particularly well suited for heavy deposits, and there is neither excessive grain growth nor roughness. Deposits can be of $\frac{1}{4}$ in. radial thickness or more, the limit of thickness deposited being determined by economic considerations rather than by any property of the plating bath.

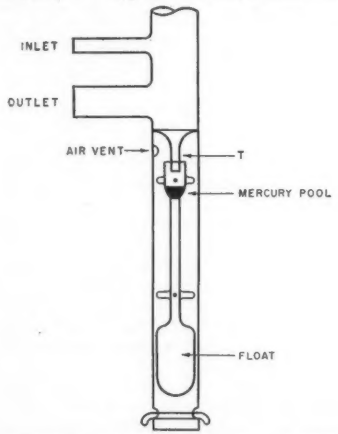
Machining qualities are about the same as those for alloy steels, with a tendency to be tough, but machining can be effected readily with high-speed tools. Machining of inside bores is somewhat more difficult, but honing or grinding is easily applied.

As an example of rebuilding by this method, the renewal of a 20 in. diesel cylinder liner can be accomplished with 12·3 lb. of deposited metal. A replacement casting, by comparison, would weigh 1,720 lb. and would require extensive machining.
(Automatic Industries—December 1, 1951)

Constant-Level Device for Liquids

A COMPACT, easily-constructed device for maintaining a constant liquid level in laboratory apparatus has been recently developed by D. E. Couch and Abner Brenner of the U.S. National Bureau of Standards. Although designed primarily for small installations, the leveller should also prove useful on large-scale equipment.

While several devices for maintaining a constant level of liquid in tanks are commercially available, none of these are satisfactory for use with small laboratory set-ups, such as electroplating baths operated at elevated temperatures. Usually they employ a syphon arrangement or make use of an electrical circuit to operate a solenoidal valve or pump. Those syphon levellers which receive water directly from the tap are not adaptable to plating baths because they syphon off part of the bath when the level is raised by the addition of a large piece of work. The electrical devices, besides being rather expensive, are not sufficiently portable for use with small baths. The Bureau's leveller eliminates many of the disadvantages of the previous types. It takes water directly from the tap, is of inexpensive construction, and can be easily moved from one installation to another.



Schematic diagram of the device developed recently for maintaining a constant liquid level in electroplating baths. Water from the tap enters through the inlet tube and flows out through the outlet tube just below. When the bath level drops, the float goes down, and water from the tap runs into the bath through the small tube T. Then, as the bath level rises, the mercury pool comes up to close off the tube T, and all the tap water passes out through the outlet. A small air vent prevents the column from flooding with water

The new leveller employs a water inlet and an overflow, or outlet pipe, to maintain a constant head. A mercury valve, attached to a float, allows the water to flow into the bath if the bath level is lowered and prevents flow outward when the level of the bath rises.

The device takes the form of a vertical tube with inlet and outlet connections near the top. Just below the outlet connection the tube is sealed off except for a smaller-diameter tube which extends below this point, connecting the upper section of the larger tube with the lower. An open cup of mercury is supported below the small connecting tube by a float which rises and falls with the liquid level in the lower section of the larger tube. When the bath level rises, the float also rises, causing the mercury cup to seal off the lower end of the small connecting tube. All of the water entering through the inlet is then rejected and is eliminated through the outlet connection. When the bath level drops, the float descends, taking with it the mercury cup, and the water runs into the bath through the small tube.

Levellers of this kind can be made in any size, for solution depths of 10 cm. or more. None of the dimensions are critical; however, the tube should be of sufficient size that it will

not become clogged by the small particles of sediment that may enter with the tap water, and the mercury cup must be large enough and so centred that it will slide freely up over the small tube without touching. A convenient diameter for the larger tube is 25 mm. In order for the water to flow freely, the overflow tube should be about 2 cm. in dia., and the float should have about 3 mm. clearance with the surrounding tube.

At the Bureau, one of the new levellers has been used on a 6-litre bath operating at 85° C., and another has been employed with a chromium-plating bath of commercial size. Both have functioned satisfactorily for several months, maintaining liquid levels constant to within 5 mm.

Automatic Plating

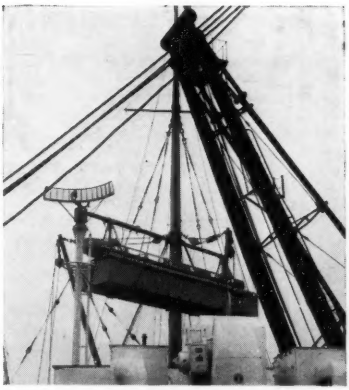
OUR photograph shows an Efco-Udylite Junior automatic plating plant, manufactured by Electro-Chemical Engineering Co. Ltd., Netherby, Queens Road, Weybridge, Surrey, being loaded for shipment at the London docks for a Swedish customer. The machine is one which was shown at the recent British Industries Fair, and the specification and process sequence is as follows:

It is a fully automatic electro-plating machine which incorporates ten stations: electro-clean, cold rinse, acid dip, cold rinse, electro-plate, cold rinse, hot rinse, dry, load and unload. Maximum output is 100 racks per hour, or about 200 sq. ft. of work per hour.

The machine is of the "return" type, racks of work being loaded and unloaded adjacently by one operator. Normally a pneumatic drive is used for the lifting and traversing operations; alternatively, a hydraulic unit can be supplied.

The equipment is particularly suitable for zinc, cadmium and tin plating. It is also used for nickel-plating with a separate chromium-plating plant and has a definite application for phosphate and other non-electrolytic processes.

Overall dimensions are: Length 28 ft. 6 in.; width 8 ft. 6 in. including exhaust boxes; height 8 ft. 6 in.



Loading the Efco-Udylite Junior automatic plating plant at the London Docks

The process tanks are built as a single unit of mild steel construction, subdivided into compartments 26 in. wide × 36 in. deep, suitably lined where necessary.

TABLE SHOWING PROCESS SEQUENCE, ETC.

	Length of tank	*No. of racks in tank*	*Immersion time in seconds* 75 *racks per hour*	100 *racks per hour*
	ft. in.			
1. Cathodic cleaner ...	5 6	3	118	82
2. Anodic cleaner ...	4 2	2	70	46
3. Cold water rinse ...	1 10	1	22	10
4. Acid dip	4 2	2	70	46
5. Cold water rinse ...	1 10	1	22	10
6. Plate	23 0	16	742	550
7. Cold water rinse ...	1 10	1	22	10
8. Hot water rinse ...	1 10	1	22	10
9. Dryer	5 6	3	118	82
10. Load and unload ...	4 8	3	118	82

The overall dimensions of the racks are: 2 in. to 6 in. wide × 12 in. long × 24 in. deep.

Exhaust boxes are normally provided for cleaning tanks, acid dip and hot rinse, whilst steam coils or immersion heaters may be used for heating.

The mechanism consists essentially of a lifting frame incorporating a specially designed cathode track from which the racks are suspended during the transfer operation. A secondary mechanism is used to move all the plating racks laterally, this movement being synchronised with the raising and lowering of the lifting frame. A complete transfer operation takes place every 48 sec. when an output of 75 racks per hour is required or every 36 sec. for an output of 100 racks per hour, the time taken for the transfer operation being 26 sec. Power for the lifting and traversing movements is supplied by two air cylinders, fed from a compressor which is driven by a 5 h.p. electric motor. An air receiver, fitted with the necessary valves and gauges is also supplied.

The machine has no conveyor chain and requires no electrical control panel or limit switches.

P.T.F.E.

IN "Background," the I.C.I. technical newsletter for July, mention is made of the new I.C.I. creep test research station. The question of creep at the high temperatures operating in turbo-jet engines due to the tremendous centrifugal force is obviously an important factor. The new test station is at the Witton factory of the Metals Division of I.C.I. in Birmingham and consists of sixty creep testing machines.

Reference is also made to a new material P.T.F.E., which is an inert plastic called polytetrafluorethylene. It is a white or mottled grey plastic material with a similar waxy feel to polythene. Its properties are as follows:

Mechanical

Tensile Strength.—1,500 to 2,500 p.s.i on normal moulded samples. Can be increased to 10,000 to 15,000 p.s.i by rolling.

Elongation to break.—50 to 400 per cent. depending on method of fabrication.

Impact Strength.—High, especially at elevated temperatures.

Pliability.—Extremely good in thin sheets, which do not crack on flexing at − 75° C.

Physical

Density.—2.2 grams/cc. at 25° C. Bulk density of polymer is 0·42 − 0·45 grams/cc. Compression ratio between 3·9 and 4·3 : 1.

Shrinkage on Moulding.—Approx. 5-10 per cent. at right angles to direction of application of pressure, depending on heating cycle.

Thermal

Melting point.—No true melting point, but subject to deformation under load as temperature raised. At 327° C. solid phase transition causes sharp drop in strength. Above this temperature, material resembles hard rubber and has no flow in normal sense of word.

Decomposition point.—In region 400-500° C.

Coefficient of cubical expansion.—Varies from 15 to 35 × 10^{-5} per cm.^{3} per ° C. over the temperature range 20° C. − 300° C. At 327° C. increase in volume of about 25 per cent., and at 23° C. an increase of 1 per cent.

Thermal conductivity.—About the same as that of polythene, i.e., 2.1 cal./cm.^{2}/hr./° C./cm.

Inflammability.—Non-inflammable.

Chemical

Solvent.—None known.

Chemical corrosion.—Attacked only by molten alkali metals.

Effect of light.—Stable.

Effect of water.—Not wetted. Absorption nil, though powder may absorb up to 0·5 per cent. water under normal exposure conditions.

Electrical

Dielectric Constant.—2·0 frequency range of 60 to 10^9 cycles.

Power Factor (tan δ).—0·0001 over above range.

Dielectric Strength.—1,500-1,800 volts per mil. on samples 0·005 in. thick.

Tracking.—Non-tracking, as no conducting path left if arcing occurs. If electrodes become red hot, may react with "Fluon" forming carbon deposit.

Static charge.—"Fluon" easily develops static charge. Great care should be taken to avoid contamination.

The material has been found extremely useful for resistance to heat, corrosion, chemicals and solvents—typical applications include gaskets and packings, valves and pumps in chemical plant, protective linings, tubing for carrying acids and corrosive liquids—as an insulator for high frequency applications as well as a valve and cathode ray tube holders.

Protective Coatings for Iron and Steel

THE work of the British Iron and Steel Research Association, Protective Coatings (Corrosion) Sub-committee, is described by F. Fancutt, F.R.I.C., A.M.I.Chem.E., and J. C. Hudson, D.Sc., F.I.M., in the August, 1952, issue of the *Journal of the Oil and Colour Chemists' Association*. and summarised as follows:

The authors survey the result of investigations of protective coatings for structural iron and steel extending over twenty years. In the field of painting, the research has thrown into relief the vital importance of correct surface preparation and the value of using inhibitive priming paints. Studies of the formulation of anti-corrosive paints, both for land and marine structures, are in progress in collaboration with the paint industry. In the field of metallic coatings, basic data have been obtained for the performance of aluminium, cadmium, lead, tin and zinc coatings under various conditions of atmospheric exposure. The durability of zinc coatings has been shown to be roughly proportional to their thickness and, but little affected by the process of application. Sprayed aluminium has proved an effective coating, but lead coatings have given good results only in an industrial atmosphere, where they become covered with a protective sulphate film.

The conclusions drawn from this work are that great strides are being made in the development and application of protective coatings for iron and steel and it may fairly be claimed that the work of the Protective Coatings (Corrosion) Sub-committee has served, and will continue to serve, a valuable purpose in investigating such coatings and in making an impartial assessment of their relative values. It would seem that further research is desirable in the following directions.

(*i*) *Surface preparation of metallic coatings for painting*
The old difficulty of securing good adhesion of paint to newly galvanized sheet is well known. Similar difficulties arise when painting over non-ferrous metal surfaces and it is often usual to overcome these by using a chemical surface treatment. There is need for systematic investigation of these chemical surface treatments and also of the formulation of the most suitable protective paints for application to metallic coatings.

(*ii*) *Blistering of paint films*
The blistering of paint films, more particularly of ships' bottom compositions, is still imperfectly understood despite notable work by members of the Association and others. There is room for consistent and systematic research in this field.

(*iii*) *Phosphate coatings*
Many factors still need clarification relating to the use of phosphate coatings, particularly when phosphating processes are applied to structural steel. Reliable specifications and performance tests would be of particular value.

(*iv*) *Plastic coatings*
Subject to the comments about adhesion and damage made in the previous section, there is clearly a considerable future for enveloping protective coatings of plastics material applied by spraying or other means. The production of successful coatings of this type involves both development and testing.

Finally, the authors emphasise the necessity for adequate supervision of protective processes in industry. It is useless to adopt the best and most modern protective processes unless they are applied under correct and well-controlled operating conditions. Phosphating processes especially can only be fully effective if carried out under rigid control.

"SABLE" BRUSHES

THE British Brush Manufacturers' Association says it is aware that artists' and other fine-hair brushes are being sold under false descriptions. The offence usually takes the form of describing as a "sable" brush, a brush which is not made, or not wholly made, of sable hair. The Association holds that the term "sable" should only be applied to the hair of the sable, kolinsky or weasel. It is, however, being applied to brushes containing ox hair, squirrel hair, and other kinds of hair.

The Association, therefore, gives notice that it is looking for evidence of offences in order to bring prosecutions under the Merchandise Marks Act.

THE FUTURE OF VITREOUS ENAMEL

THE enamelling industry derives from an ancient art, yet it is essentially a young, growing industry which has barely scratched the surface as far as its potential goes. The American Ferro Enamel Co. found that possibilities that are open to it in the line of developed design requiring one or several of its very practical properties, are fascinating.

Uses for vitreous enamel are varied and boundless. It is now being utilised in architecture where steel as a wall panel has been a negligible factor and is now becoming, in the form of enamelled steel, an increasingly popular curtain wall material. Although there is no such thing as a non-chippable vitreous enamel, it is now considered a very rugged material by engineers, architects, and commercial users. For instance, thread guides, which would be cut in half by the terrific friction of the racing thread, have a greatly extended life when coated with porcelain enamel. Hard steel will not stand up under the abuse of coal in a coal chute, but a vitreous enamel coating extends its life many times. Vitreous enamel can combine the beauty and practicability of metal shaping with a permanent, heat-resistant, acid-resistant, salt water-resistant

A portion of a modern American house whose walls, door and canopy are made of enamel. This is an interesting illustration of the potential of vitreous enamel in architectural developments

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finish. It is also corrosive-resistant, abrasive-resistant, an electrical insulator, probably the easiest material for radioactive decontamination, extremely flexible as to texture and colour, and reflectant.

Formerly thought of only as a decoration, vitreous enamel is now being used also in structural parts. The Otis Elevator Co. in the U.S., for instance, has discovered its practicability for coating the step risers of escalators. Stainless steel mars, scratches and becomes streaky when thousands of toes bump, scrape and rub on an escalator step riser. A coating of porcelain enamel so solves the problem that Otis Elevator today utilises this finish exclusively in their escalators.

The Bettinger Corporation of Massachusetts, a pioneer in developing new uses for vitreous enamel, has given the task to its research engineers to experiment with vitreous enamel for many new fields of industrial applications. They are extending, for instance, the life of tanks, pipes and fittings which are attacked by corrosive materials or electrolytic action. Textile machines, leather product equipment, etc., are now employing vitreous enamel. Artistically, for sculptural work in design and decoration, it is also making progress. Architectural uses are being developed and include both extensive interior and exterior uses. Bettinger has developed a wide angle reflectorised vitreous enamel which reflects up to 500 ft. and is rated highly by safety engineers; and a chalkboard to replace the old style blackboard. It is available in a variety of colours, has excellent surface properties and is easily cleaned.

Vitreous enamel is no longer difficult to work with. In fact, it has become tremendously versatile and is adaptable to various grades, stages and qualities of sheet metals. Ideally, however, "enamelling iron" and soft grey iron castings are preferred. Cold rolled steel can also be used as a base, and even, in some instances, hot rolled. Recent developments have indicated that commercial practicability may be attained in enamelling on stainless steel, and such high temperature alloys as Inconel and Monel. Enamelling is also successful for some purposes on aluminium. So-called artistic metals, such as copper and silver, can also become bases for enamelling. Bettinger engineers have successfully enamelled on some of the particularly special alloys such as Kovar. In addition to sheet metals, cast metals, such as cast iron and cast steel are suitable bases for enamelling, although the technique is different, both in the preparation of the metal and in the firing cycle.

A real challenge exists for modern ceramists to develop all the possibilities inherent in the almost fabulous part-old, part-new process of vitreous enamelling. Forward thinking can develop this industry to the benefit of industry as a whole as well as the consuming public.

Mr. L. H. Downs

Blundell, Spence and Co. Ltd., announce as from 22nd July, Mr. Leslie Hall Downs, C.B.E., M.A., M.I.Mech.E., has been appointed a director.

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GLAND PACKING FOR SULPHURIC ACID

GLAND packings on pumps in sulphuric acid plants are always a difficulty. Some months ago a combination assembly of gland packings which was supplied by Crane Packing Ltd. of Slough, was installed in a pump handling sulphuric acid. The main gland of the pump was packed with an assembly of C.F.2. packings consisting of alternate rings of styles 4.S.M.G. and 4.G.L. with the former used as headers and the pilot gland packed with rings of Cranpac style 896, also manufactured by the Crane company. So far, this assembly of packings has given some seven months' trouble-free service.

The C.F.2. range of packings which were introduced are based upon a chemically inert polymerised plastic material, polytetrafluoroethylene. Cranpac style 896 is a braided asbestos resistant lubricant. This packing has been used on acid services for many years but since the introduction of the C.F.2 range it has been largely superseded, at any rate as a main packing, when acids or chemicals of a very corrosive nature are being handled. A special booklet entitled *Gland Packings for the Chemical Industry* is available.

Mr. C. E. Bridges, who was recently appointed general manager of the Society of British Paint Manufacturers.

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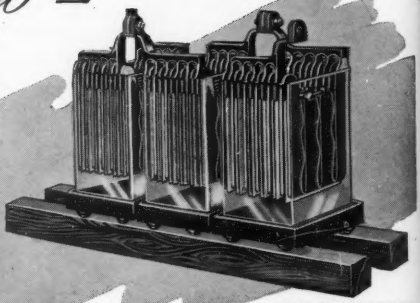

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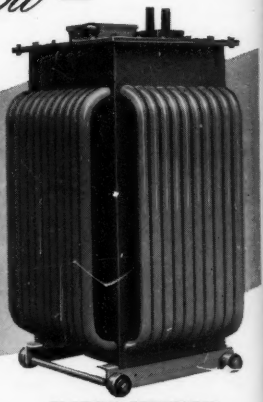

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